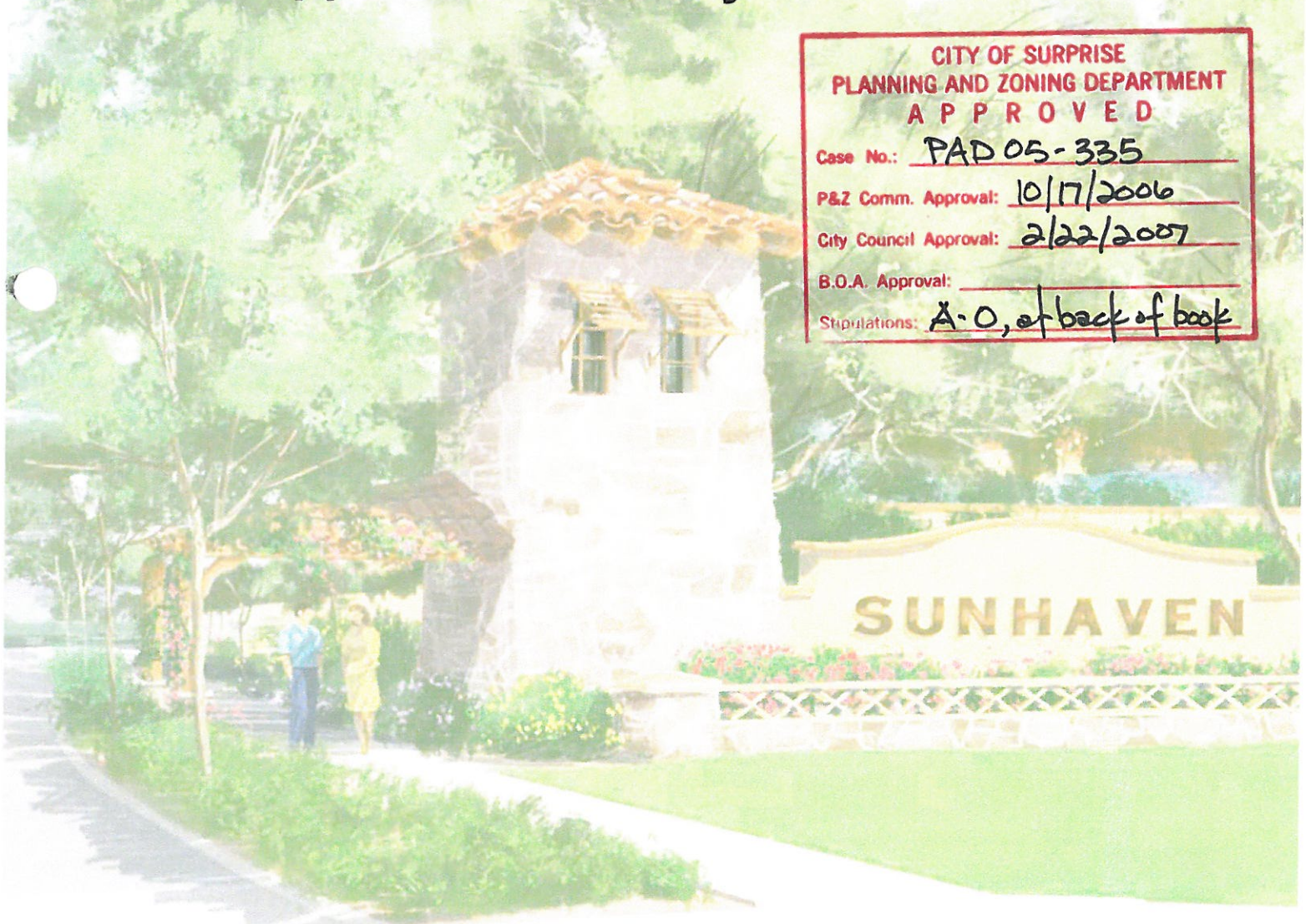
Sunhaven - PAD

A Master Planned Community

Planned Area Development
Surprise, Arizona
Final Approval – February 2007



CITY OF SURPRISE
PLANNING AND ZONING DEPARTMENT
APPROVED
Case No.: PAD 05-335
P&Z Comm. Approval: 10/17/2006
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B.O.A. Approval:
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Sunhaven

Master Planned Community

Planned Area Development

Original TAC Submittal to City of Surprise
August 2005
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SUNHAVEN
PLANNED AREA DEVELOPMENT
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PLANNED AREA DEVELOPMENT

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INTRODUCTION AND EXECUTIVE SUMMARY

Sunhaven is an approximately 2,116 acre proposed Planned Area Development (PAD) located in unincorporated Maricopa County. Although currently within the County, it is the intent of the property owner to request annexation into the City of Surprise prior to final approval of this PAD document. The property is an irregularly shaped parcel, generally bounded by Dove Valley to the north, 187th Avenue to the east, the Dixileta Road Alignment and Grand Avenue to the south, and 203rd Avenue alignment to the west. The subject property falls within the Surprise General Planning Area.

The property was previously entitled as a Development Master Plan with zoning by Maricopa County. These existing zoning entitlements include approval for a total of 9,017 dwelling units. This new Planned Area Development Zoning application reduces the number of dwelling units to 8,001, a reduction of approximately 11%.

This Planned Area Development (PAD) application will amend the equivalent zoning that will be adopted when the property is annexed by the City of Surprise. This PAD represents the evolution of an extensive project visioning and community theming process conducted by the master development team. The overall vision of the PAD is to create a community that values the natural planning determinants of the site, incorporates the various goals of the City of Surprise General Plan, creates a strong sense of community by providing community-wide open spaces, design amenities, and public facilities that are linked together by a comprehensive trail system, creates an efficient circulation system to serve both the community as well as the entire region, all of which results in a balanced sustainable land use plan where residents can live, work and play in an exciting and vibrant master planned community. If approved, this extensive effort will result in substantial improvements to the existing approved land use plan and will be the foundation for the development of a high quality master planned community in the City of Surprise.

The Sunhaven PAD offers a broad mix of residential housing types, including a mix of the Low Density Residential, Medium Density Residential, and High Density Residential land use categories. The land use plan, which is consistent with the City of Surprise General Plan, includes an overall target density of 3.8 dwelling units per acre with a single family residential density of 3.1 dwelling units per acre. 8,001 dwelling units are proposed, with a projected population of just over 21,000 residents. The plan also envisions major employment centers located along the western edge of the property, between the existing BNSF Railroad and a proposed major arterial running parallel to Grand Avenue. The developer is negotiating with the Maricopa County Community College District in an effort to locate a MCCCD campus site within the project in the employment area. Additionally, commercial centers have been located throughout the development, ranging from major town center community/regional commercial parcels to serve the site and surrounding area to smaller neighborhood commercial centers to serve the local population within the Sunhaven Community. These commercial and employment centers are located along the major arterial roads proposed within the development. Proposed community amenities include one community park and one neighborhood park, substantial open space areas, three elementary school sites, and multiple pocket parks throughout the community, within and adjacent to the residential development parcels.

A major community-wide trail system is proposed that will connect many of the major amenities throughout the development. These trails will utilize the existing natural desert washes that traverse the property and will connect many of the residential development parcels, commercial centers, schools and park facilities of the project. The plan calls for a general goal of an approximately ¼ mile walking distance from residential lots to a park or open space or a trail leading to a park or open space. Scenic view corridors will also be prevalent throughout the project along the desert washes.

Another significant revision from the existing zoning approval is the change to the circulation pattern within Sunhaven. The approved zoning plan has two major arterial streets that do not align with the transportation network in the Surprise General Plan. The proposed plan solves this problem by providing a connection between an existing railroad crossing at Grand Avenue and the Lone Mountain alignment, creating a link between the interior of Special Planning Area 4 and Grand Avenue. The plan has also been revised to accommodate the continuation of Tillman Boulevard, a planned major arterial that parallels Grand Avenue to provide transportation links to the north and south of Sunhaven.

Ingress and egress to Sunhaven will initially be oriented from Grand Avenue at 203rd Avenue from the southwest and Dove Valley Road on the north. In the future, additional access will be provided by others along Tillman Boulevard and 187th Avenue from the south and Lone Mountain Road from the east. A series of collector and local roads will provide access to the individual development parcels throughout the community.

Sunhaven contains wash corridors that have been designated by the Army Corps of Engineers as 404 Waters of the United States. The development limits associated with the washes are reflective of an engineering analysis which provides an initial look at probable development limit lines as necessary to recognize and address the potential for erosion and wash migration. The exact limits of the wash corridors will be determined at the time of platting for the individual development parcels, as more detailed grading and hydrologic analysis is prepared on a site specific basis.

The surrounding property ownership immediately adjacent to the property consists of the Daimler/Chrysler Proving Grounds to the north, various private land holdings to the west, a combination of private land holdings and State Trust land to the east, the BNSF Railroad and Grand Avenue along the southwest, and a private land holder and Central Arizona Project (CAP) land owned by the United States of America to the south.

This document is organized into four major sections with supporting appendices. These sections include a review of the site's location and regional context, the physical characteristics of the site (site analysis), the proposed master plan elements and the regulatory development standards and design guidelines. This document has been prepared to satisfy the project narrative and graphic requirements for a Planned Area Development zoning application.

The Sunhaven PAD offers many improvements over the existing DMP approved by Maricopa County, including:

- An 11% reduction in the total number of dwelling units from 9,017 to 8,001.
- Creation of a significant community wide trail system that connects residential, recreational, and educational amenities.
- Recreation areas dispersed throughout Sunhaven to provide convenient access and close walking distances to homeowners.
- An improvement to the area wide circulation system through the connection of Lone Mountain Road to Grand Avenue and the introduction of Tillman Boulevard.

A. LOCATION AND REGIONAL CONTEXT

1. Property Description and Location

Sunhaven is a proposed 2,116 acre Planned Area Development within the City of Surprise planning area. Although currently within unincorporated Maricopa County, it is anticipated that the project will be annexed into the City of Surprise prior to approval of this PAD zoning application. Upon annexation, the City will establish zoning on the property which is the equivalent of the zoning that was approved in Maricopa County (see discussion below for more detail on the County zoning approval). The property is an irregularly shaped parcel, generally bounded by Dove Valley to the north, 187th Avenue to the east, the Dixileta Road Alignment and Grand Avenue to the south, and 203rd Avenue alignment to the west. The subject property falls within the Surprise General Planning Area. A graphic representation of the Sunhaven property and vicinity is provided on **Figure 1**: *Regional Vicinity Map and Municipal Boundaries.*

2. Property Written Legal Description

The property consists of approximately 2,116-acres located in the northwest valley in unincorporated Maricopa County, at Township 5N, Range 2W, Sections 17, 19, 20 and 21. Its southwestern boundary borders Grand Avenue and the BNSF Railroad right-of-way. The northern boundary of the property is bounded by Dove Valley Road with vacant lands along the west, east and southern edges. The property is more specifically described in **Appendix A.**

3. Ownership, Control and Applicant's Interest

The property contained within this PAD application is owned by Sun Haven Associates, LLC, Sun Haven/Grand Avenue Master Planned Community, LC, 203 Properties, LLC, and Sun Haven 1, LLC. The applicant, Sun Haven 1, LLC, is a joint venture created for the purpose of entitling and developing the Sunhaven property. The managing member of Sun Haven 1, LLC is Element Homes and the other members are Standard Pacific Homes of Arizona and Homes by Towne. Sun Haven 1, LLC has received authorization from 203 Properties, LLC, Sun Haven Associates, LLC and Sun Haven/Grand Avenue Master Planned Community, LC to apply for rezoning of the property.

4. Discussion Regarding Existing PAD Entitlement

In February, 2003, the Maricopa County Board of Supervisors approved the Sunhaven Ranch Development Master Plan (DMP2002003) and Zone Change (Z2002066) for the property. The approved DMP and zoning established a mix of land uses, including various residential densities, commercial, mixed use employment, schools, recreational open space, and natural open space for development on the property which will be adopted by the City as equivalent zoning upon annexation. The total number of residential units approved through the DMP and Zone Change is 9,017 for an overall gross density of 4.3 dwelling units per acre. The plan also included approximately 183 acres of commercial land use, 147 acres of employment land use, and 171 acres of High Density Residential land use.

5. Surrounding Property Ownership

The property ownership pattern within the area is provided on **Figure 2,** *Property Ownership.* The surrounding property ownership immediately adjacent to the property consists of the Daimler/Chrysler Proving Grounds to the north, various private land holdings to the west, a combination of private land holdings and State Trust land to the east, the BNSF Railroad along the southwest, and a private land holder and land owned by the United States of America to the south.

6. Regional Plans and Facilities

Below is a discussion of various existing regional plans, facilities and infrastructure within the area.

a. Municipal Boundaries

The Sunhaven property is approximately 3 miles from the incorporated boundary of Surprise. A companion application to annex the Sunhaven property is being processed concurrently. **Figure 1,** *Regional Vicinity Map and Municipal Boundaries* shows the location of the property in relation to the various existing local and county jurisdictions.

b. Surprise General Plan

The Surprise General Plan Land Use Plan identifies the property as a combination of various land uses. The primary land use, comprising more than two-thirds of the property is Low Density Residential (3-5 du/ac). A small portion of the property along the eastern edge is designated as Suburban Residential (1-3 du/ac). There is a small amount of commercial land use designated immediately east of the 203rd Avenue alignment north of the Dixileta alignment. The remainder of the property west of the 203rd Avenue alignment is designated as Employment land use.

c. Grand Avenue

Currently, Grand Avenue adjacent to the property on the southwest is a four-lane median-divided roadway, but is planned to be a six-lane grade separated expressway by the Year 2030.

d. Other Regional Land Use Impacts

1. Luke Air Force Base Auxiliary Field 1

Luke Air Force Base Auxiliary Field 1 is located approximately 3 miles southwest of the property. A portion of the subject property is within the 65 Ldn noise contour line. See **Figure 4:** *Existing Site Conditions* for the location of Luke Air Force Base Auxiliary Field 1 65 Ldn F-16 Noise Contour line.

Appendix G includes a letter from James Mitchell, Director of the Community Initiatives Team of the Department of the Air Force. This letter indicates that the proposed land use plan for Sunhaven is compatible and consistent with military operations at Auxiliary Field #1 and the attendant noise contour.

2. Daimler/Chrysler Proving Grounds

Daimler/Chrysler Proving Grounds is located on approximately 5,484 acres of land immediately north of the subject property. A general plan amendment has been approved for this property to establish future land uses.

3. Other Planned Development in the Area

Several developments in various stages of planning, approval, and development are in the vicinity of Sunhaven. Southeast of Sunhaven, south of the CAP Canal and north of 163rd Avenue are Asante and the proposed Asante North projects by Lennar Communities Development Inc. Both are on the east side of the BNSF right of way. Southeast of Sunhaven and northeast of the Asante projects are Desert Oasis and Desert Oasis of Surprise, and Sunrise Ranch. South of Sunhaven on the southwest side of Grand Avenue is Chaparral Rancheros I and II, Rio Rancho, Martin Acres, and Austin Ranch.

e. School Districts

Sunhaven is located within the Nadaburg Elementary School District. The site is not located within an existing high school district. The closest elementary school is the Nadaburg Elementary School located at 32919 Center Street, near Grand Avenue and 211th Avenue. This school also includes a pre-school and special education program.

f. Water and Wastewater Services

Water –Sunhaven lies within Special Planning Area (SPA) 4 of the City of Surprise. However, a portion of the site lies within the current service area of West End Water. The project will construct a water system to supply water from a groundwater well system. The water system will be designed in accordance with the City of Surprise or the franchise water company requirements, as applicable.

Wastewater – Sunhaven lies within Special Planning Area (SPA) 4 of the City of Surprise. The project will construct a wastewater collection system and a wastewater treatment facility to meet the needs of the development. These facilities will be designed in accordance with the City of Surprise's SPA 4 development guidelines or as modified within a Wastewater Master Plan approved by the City.

g. Refuse Collection Districts

The property and surrounding area is currently vacant and there is no refuse collection service. However, as the property is anticipated to be annexed by the City of Surprise, Surprise will provide refuse collection service once development occurs.

h. Fire Service

As the property is anticipated to be located within the jurisdictional limits of Surprise, the city will provide fire protection service to the property. The

closest fire station is Temporary Fire Station #4, located at 22443 North 163rd Avenue, approximately 6 miles from the property.

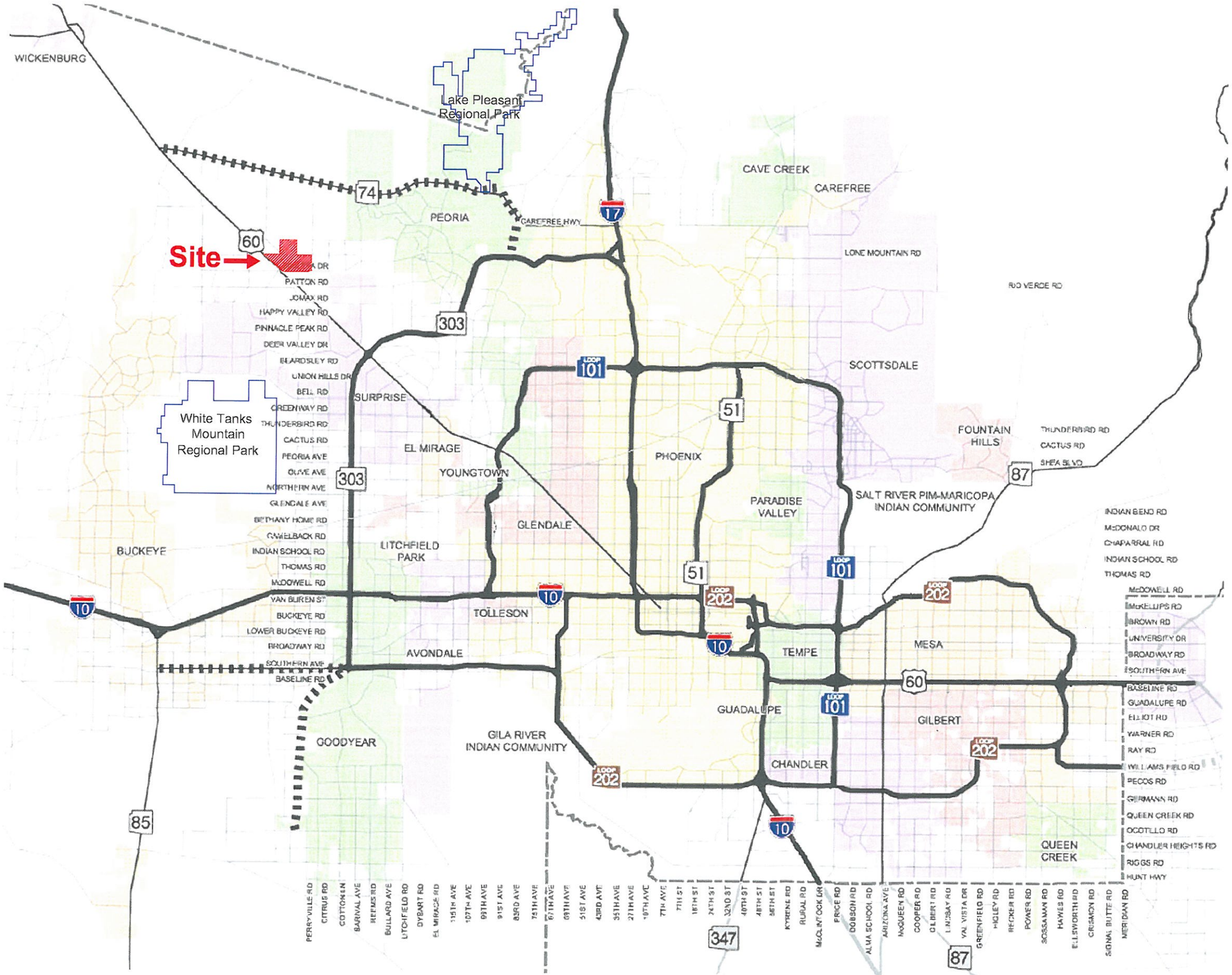
i. Law Enforcement Service
The City of Surprise will provide law enforcement services for the subject property.

Sunhaven

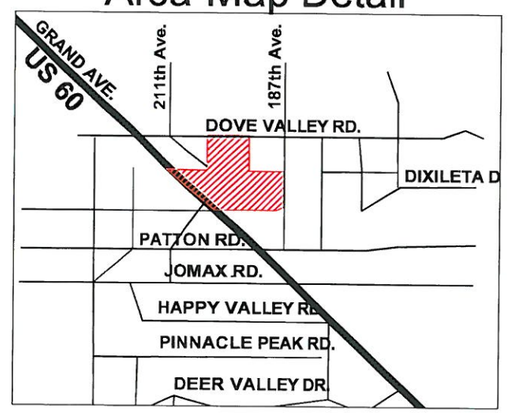
City of Surprise, Arizona

Planned Area Development

Figure 1
Regional Vicinity Map and
Municipal Boundaries



Area Map Detail



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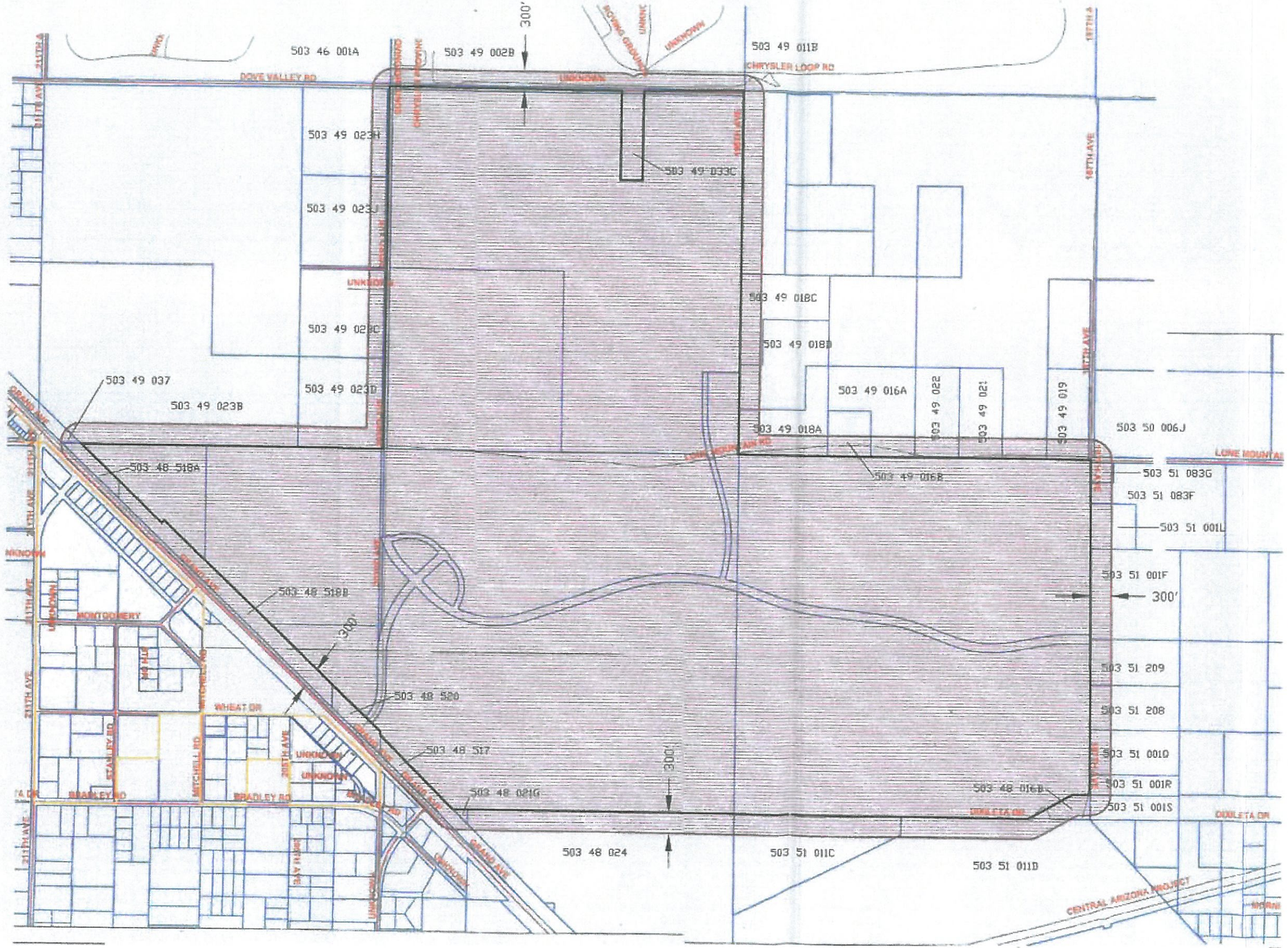
Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 2
PROPERTY OWNERSHIP



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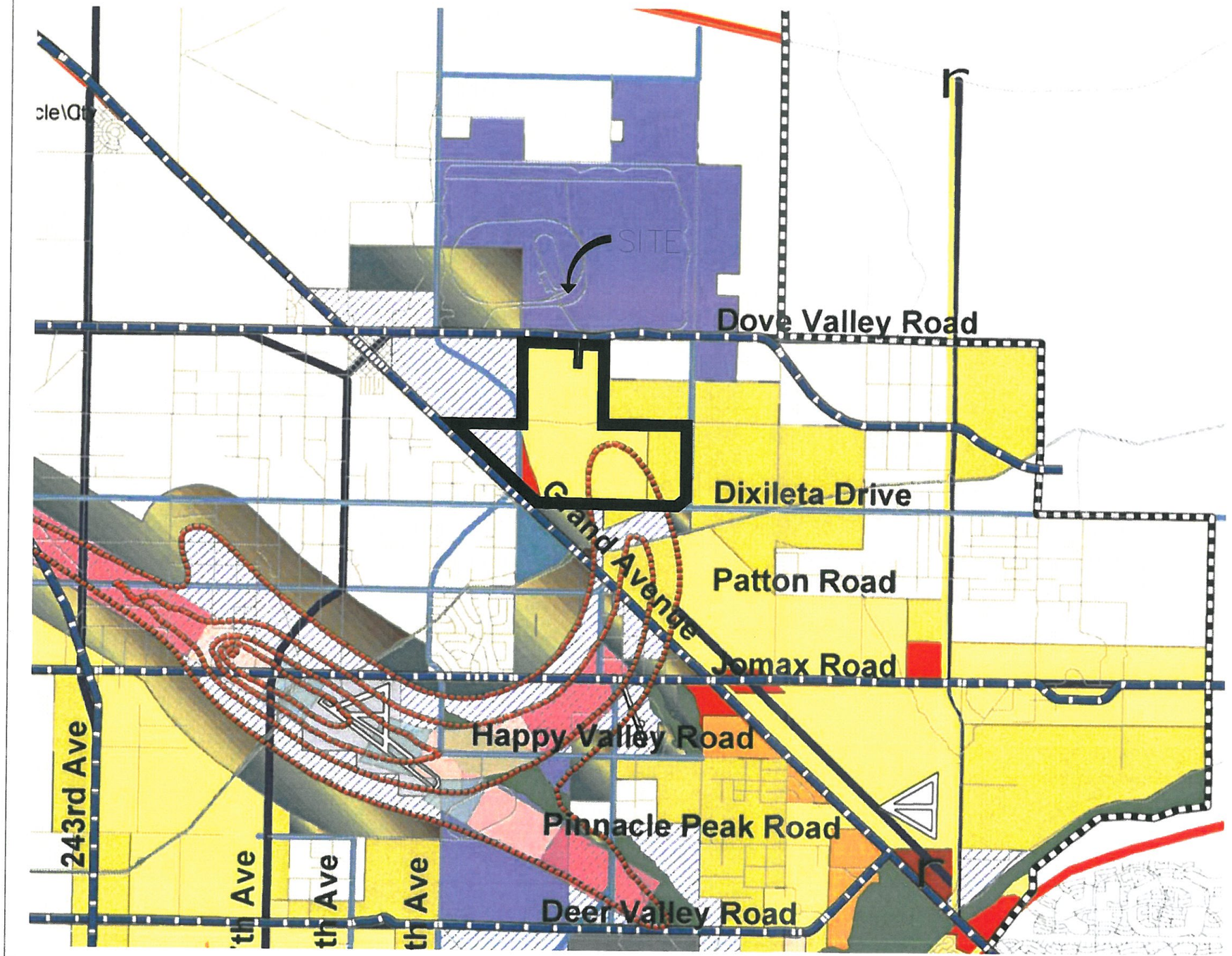
Planned Area Development
Figure 3
Existing General Plan



Land Use Classification

- Airport Preservation (0-2 Du's/Ac)
- Rural Residential (0-1 Du s/Ac)
- Suburban Residential (1-3 Du's/Ac)
- Low Density Residential (3-5 Du's/Ac)
- Medium Density Residential (5-8 Du's/Ac)
- Medium/High Density Residential (8-15 Du's/Ac)
- High Density Residential (15-21 Du's/Ac)
- Surprise Center
- Original Townsite
- Commercial
- Employment
- Mixed Use Gateway
- Agriculture
- Landfill
- Military
- Open Space
- Public Facilities
- Proving Grounds
- Mixed Use Gateway
- Resort Development

* Note: Commercial under 25 acres can be approved in other land use classifications per criteria in the General Plan.

- 1988 MAG Noise Contours
- 1995 Luke A F B Noise Contours (1997 Revised)
- Aux 1 F-16 Noise Contours
- City General Planning Area
- Maricopa County Boundary
- APZ I
- APZ II
- CLEAR ZONE

Street Classification

- Principal Arterial
- Major Arterial
- Minor Arterial
- Proposed Principal Arterial
- Proposed Major Arterial
- Proposed Minor Arterial
- Special Corridor
- PARKWAYS

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B. SITE ANALYSIS

1. Existing General Plan Analysis

The Surprise General Plan Land Use Plan as shown on **Figure 3**, *Existing General Plan*, designates the property for development with a variety of land uses. The primary land use, comprising more than two-thirds of the property, is Low Density Residential (3-5 du/ac). A small portion of the property along the eastern edge is designated as Suburban Residential (1-3 du/ac). There is a small amount of commercial land use designated immediately east of the 203rd Avenue alignment north of the Dixileta alignment. The remainder of the property west of the 203rd Avenue alignment is designated as Employment land use. The proposed PAD complies with the City of Surprise General Plan.

In order to effectively plan its 228 square mile planning area, the City created five smaller Special Planning Areas in the Surprise General Plan. The Sunhaven property is located within Special Planning Area 4 (SPA 4).

SPA 4 encompasses a total of 30,193 acres, with 22,461 acres designated for residential uses. SPA 4 includes a range of residential densities, ranging from very low density to high density residential. There are also 412 acres of land designated for commercial land use, and 1,459 acres designated for employment-based land uses. It is anticipated that this area will develop with an ultimate residential population of between 25,324 and 103,144 residents.

2. Infrastructure

Currently, the Sunhaven property is accessed from the south via Grand Avenue and 203rd Avenue. 203rd Avenue is the north/south two lane paved arterial road along the northwest boundary of the property. An existing BNSF railroad track/right-of-way and Grand Avenue define the southwest boundary of the property. 203rd Avenue extends through the property south of the Lone Mountain Road alignment, crosses the existing railroad track and connects to Grand Avenue. Dove Valley Road runs east-to-west along the north boundary of the property. There is also a dirt road that runs east-to-west along the Lone Mountain Road alignment.

There is an existing groundwater well on the project site located along the southwest portion of the north east quarter of section 20. There are existing power lines that run along the East Side of 203rd Avenue. Currently there are no water or sewer services to the property (See **Figure 4**: *Existing Site Conditions*).

3. Existing Land Use

Existing land uses on the site consist largely of vacant desert land. There is an existing stock pond on the site that was used for previous ranching and/or cattle grazing activities on the property. The BNSF Railroad alignment borders the southwest portion of the property. Immediately north of the property is the Daimler/Chrysler Proving Grounds. The remainder of the land surrounding the property is also undeveloped.

4. Existing Zoning

The zoning approved by the Maricopa County Board of Supervisors in February 2003 is a combination of R1-10, R1-6, R-4, C-2, IND-1. The areas thought to remain as natural open space were left with the existing as Rural 43 zoning. The acreage for each zoning district is as follows:

Zoning	Area
R1-10	410 ac
R1-6	900 ac
R-4	171 ac
C-2	183 ac
IND-1	147 ac
Rural 43	309 ac
Total	**2,120* ac**

* - This total is slightly higher than the 2,116 acres for the project described in this PAD document due to the rounding used in the Maricopa County case

5. Topographic Contours

The property is located within the parameters of the Hieroglyphic Mountains S.W. 7.5 – Minute United States Geologic Survey Topographic Map. The property elevation ranges from 1566 feet to 1620 feet above mean sea level. The general slope surrounding the property is to the south-southwest. The property is crossed by numerous southern trending washes. Many of the washes are deeply incised with areas of heavy erosion. See **Figure 5**: *Topography and Physical Features* for existing topography on the property.

6. Vegetation and Wildlife

The project lies within the Lower Colorado River Valley Sonoran Desert scrub biome. The dominant vegetation community is described as Creosote bush Bursage Series. The upland portions of the site support primarily creosote bush and triangle – leaf bursage. Larger ephemeral washes are lined with blue and occasionally foothill palo verde, ironwood, and velvet mesquite. Desert Hackberry, Catclaw Acacia, Graythorn, and Crucifixion Thorn occur sporadically along the washes. Cacti include a few and widely scattered Saguaros and more numerous Barrel Cactus, Buckhorn Cholla, Prickly Pear, and Hedgehog Cactus. Plant species protected by the Arizona Native Plant Law include both Palo Verde species, ironwood and velvet mesquite, and crucifixion thorn and all cactus species.

Wildlife in the project area is expected to be typical of this biome. The site is used by Wild Burros, Coyote, Kit Fox, Javelina, Cottontails and Black Tailed Jackrabbits, as well as smaller rodents such as Woodrats, Kangaroo Rats, and Mice. Birds and Reptiles are typical to the region.

7. Major Rock Outcroppings, Streams and Ponding Areas

There are no major rock outcroppings or year round streams located on the Sunhaven project site. There are several washes traversing the site from north to south created by intermittent storm runoff and there is a man-made stock pond. Drainage that leaves the site crosses the CAP Canal, travels approximately 6 miles, is impounded by the McMicken Dam, and discharges via the McMicken Outfall to the Agua Fria River.

8. Existing Drainage Patterns

The drainage flows are primarily north to south through the project. The ultimate outfall is a series of "overchutes" and drainage structures along the Central Arizona Project Canal to the south of this project. The US Army Corp of Engineers has performed a Jurisdictional Delineation of Section 404 Waters of the United States for the property. A Drainage Master Plan has been prepared and submitted to the city within this PAD package that addresses the generation, conveyance, and retention of storm waters affecting this property. See **Figure 6**, *Primary Drainage Corridors* for general size and location of drainage corridors on site.

9. Utilities

a. Water
There is currently no water infrastructure on the property. A water system including ground water wells, a water production and/or treatment facility, storage and booster stations, and a water distribution system will be constructed for that portion of the project lying with the future service area of the City of Surprise. The area of the project within the West End Water Service Area will be handled separately with that Company.

b. Wastewater
There is currently no wastewater infrastructure on the property. A wastewater collection system and treatment facility will be constructed as part of the project.

c. Electric
Electric service will be provided by Arizona Public Service. Existing electric facilities consist of an overhead, three-phase, 69 KV electric line with a single three-phase, 12 KV electric line under, hung on common poles. This pole line is located along the West Side of Grand Avenue. There are also overhead, three-phase, 12 KV distribution lines extending north across Grand Avenue, which parallel the easterly side of 203rd Avenue. The feed for the 12 KV facilities is the Deer Valley substation located approximately 6 miles south of the project site at Grand Ave. and Deer Valley Road.

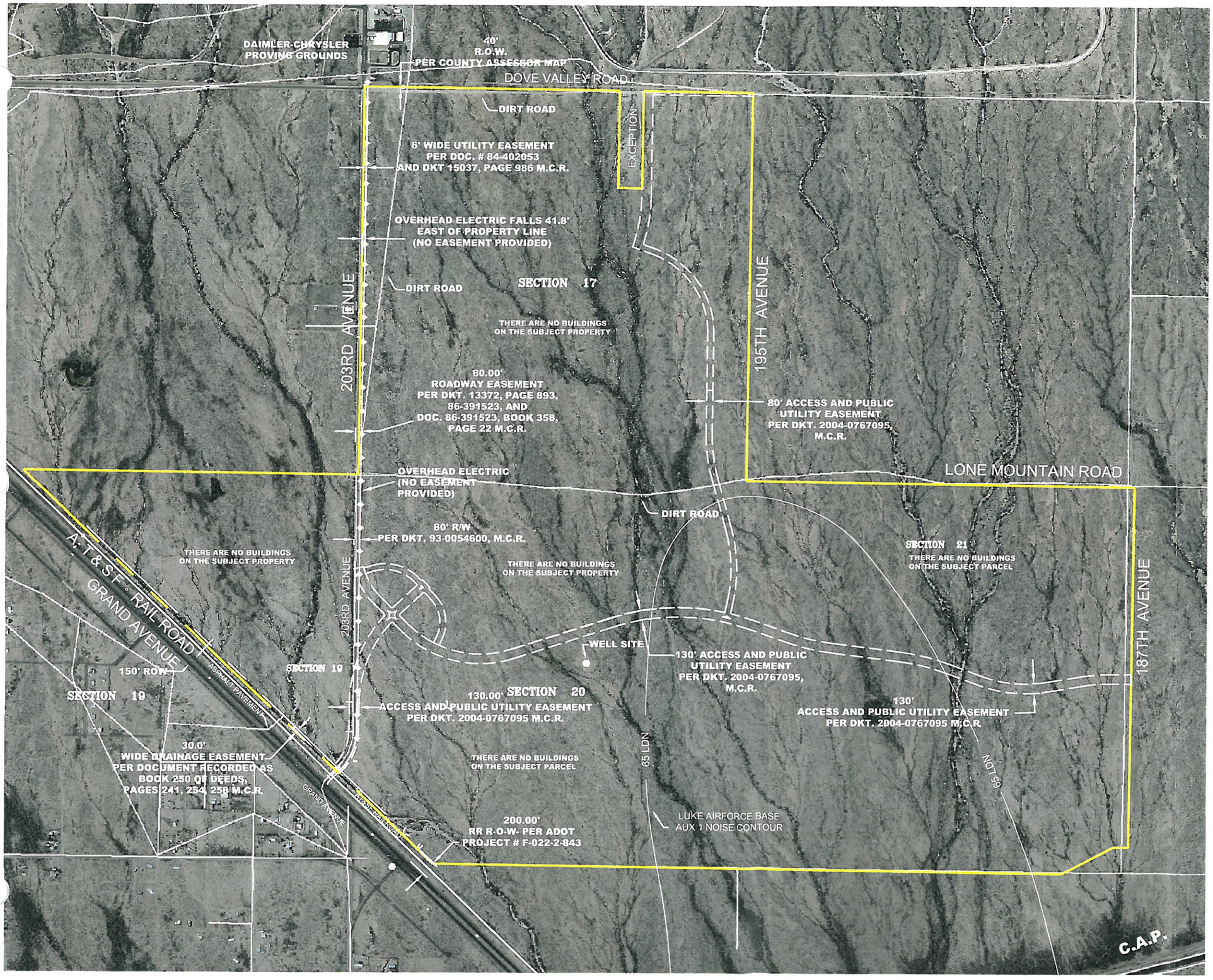
d. Telephone
Telephone service can be provided by Qwest Communications. Existing underground fiber optic facilities are located along the West Side of Grand Avenue and are expected to be used to provide service.

e. Cable Television Service
Cox Communications is the franchise provider for CATV in this area however there are no Cox communication facilities in the immediate vicinity.

f. Natural Gas Service
Natural Gas service will be provided by Southwest Gas Corporation. There is a 16-inch-high-pressure transmission gas main along the West Side of Grand Avenue. A 6-inch high-pressure line is tapped into the transmission line approximately 1700 feet northwest of the 203rd Avenue intersection with Grand Avenue and is anticipated to provide service.

10. Cultural Resources

A cultural resource survey of the site was conducted by Archeological Consulting Services, Ltd. of Tempe Arizona in June 2002. Prior to the fieldwork, site and project files were checked at the State Historic Preservation Office (SHPO), the AZSITE database, and SAM to determine if any previously recorded cultural resources were within 1 mile of the project site. The historic General Land Office (GLO) plats on file at the Bureau of Land Management – Arizona State Office were also examined. The research revealed 10 projects have been conducted nearby. The field survey inspected an area of approximately 2,124 acres including a limited area beyond the project area to determine the boundaries of sites and isolates. Overall, ground surface visibility was good to excellent, depending on vegetation density. Modern trash dumps were common throughout the parcel. Other sources of observed disturbance included two-track and dirt roads and occasional trash associated with road activities. The cultural survey report is included in the **Appendix**.



Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 4
Existing Site Conditions

DEI Professional Services, LLC
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Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8605

Date: 05-12-05
Drawn By:
Revised: 07-12-05

NORTH
Not To Scale

LVA Urban Design Studio L.L.C.
Master Planned Communities,
Land Planning,
Site Planning & Design
Environmental Analysis &
Landscape Design
7502 East Main Street
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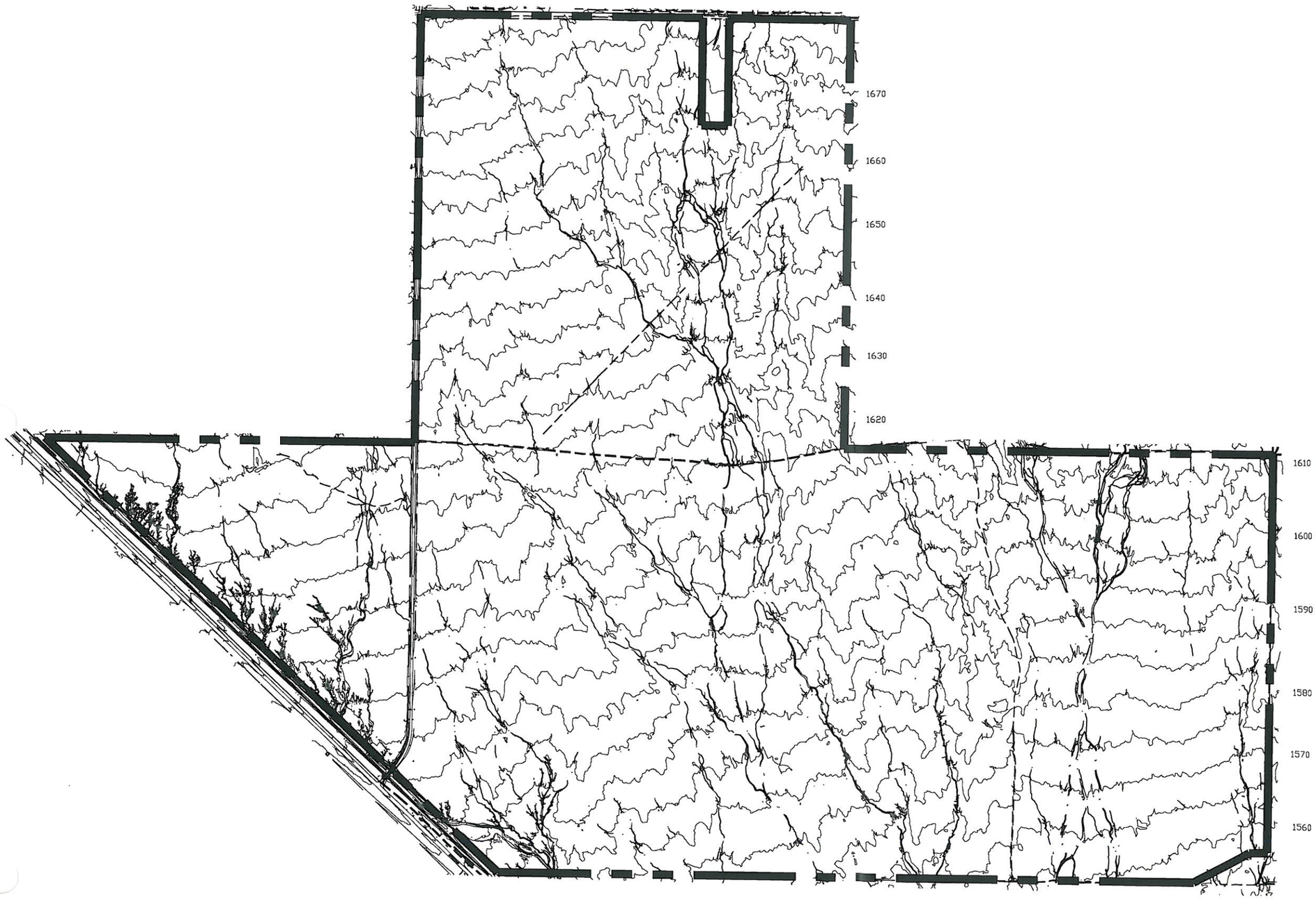

Contours at 5' Intervals

Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 5
Topographic Contours

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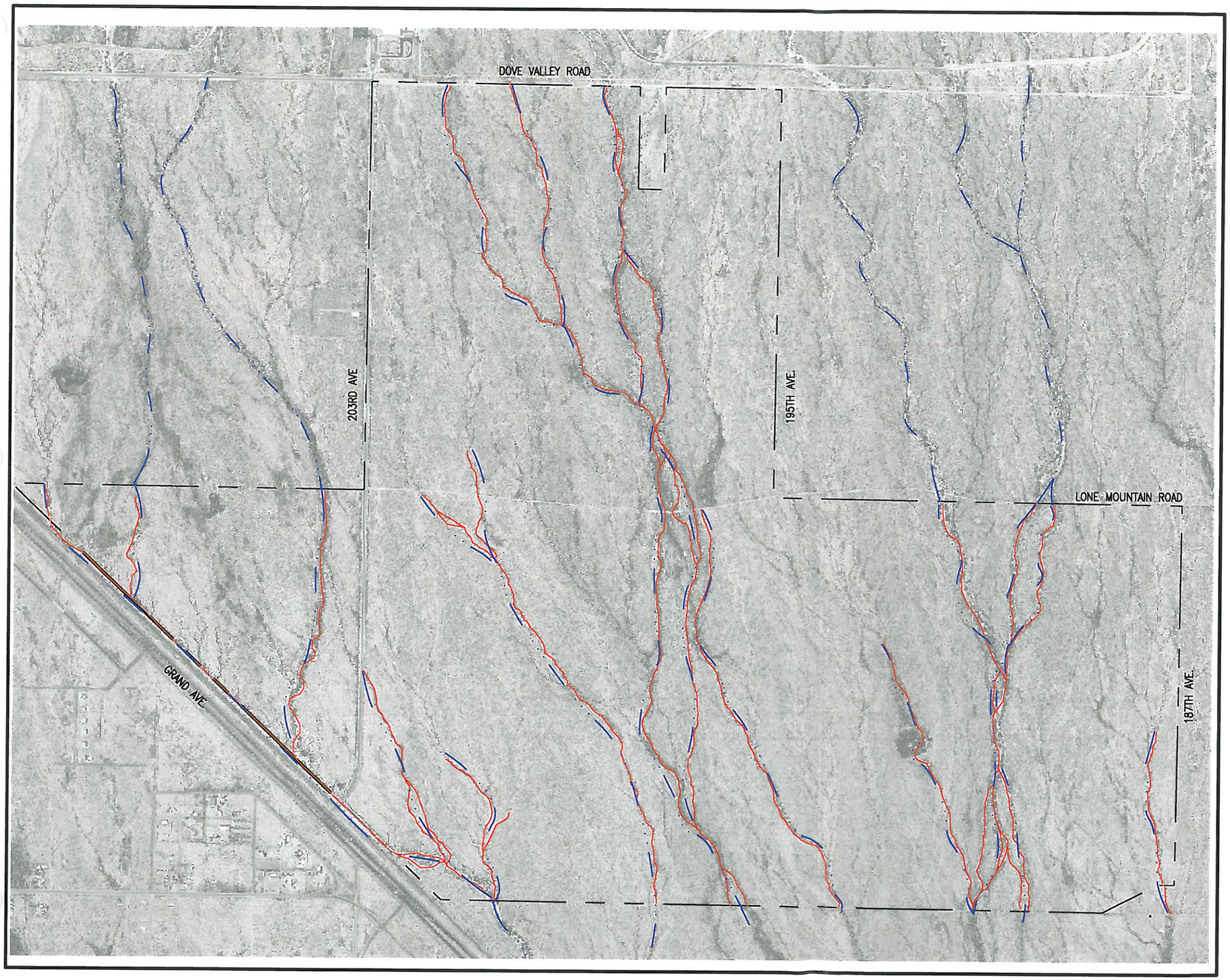

Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 6
Primary Drainage Corridors

WATERCOURSE

PROPERTY LINE

THALWEG 404 JURISDICTIONAL WATERS OF THE U.S.

Note: The delineation of the 404 jurisdictional waters is preliminary and subject to change during the permitting process.

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C. MASTER PLAN

1. Project Overview

The Sunhaven Planned Area Development represents the evolution of an extensive project visioning and community theming process conducted by the master development team. The overall vision of the PAD is to create a community that values the natural planning determinants of the site, recognizes the various goals of the City of Surprise General Plan, and creates a strong sense of community. To attain this vision, Sunhaven provides community-wide open spaces, design amenities, and public facilities that are linked together by a comprehensive trail system and creates an efficient circulation system to serve both the community as well as the entire region. The result is a balanced, sustainable land use plan where residents can live, work and play in an exciting and vibrant master planned community. If approved, this extensive effort will result in substantial improvements to the existing approved land use plan which is the foundation for the development of a high quality master planned community in the City of Surprise.

The Sunhaven PAD has been designed to offer a broad range of housing types, including single family residential, medium density residential, and high density residential, commercial and employment services, public facilities, schools, parks, trails and an open space network meandering throughout the community. The projected residential population will be served by three elementary schools, one neighborhood park and one community park. The development will also include a series of smaller pocket parks within or adjacent to the residential development parcels throughout the community. The parks, recreation and school facilities will be connected through a series of multi-use trails that meander throughout the community utilizing the existing wash corridors that cross the property in a north/south direction.

Two major wash corridors and several smaller tributaries will serve as a central theme and major amenity for the community. Substantial trails, natural and improved open spaces, scenic view corridors and recreational opportunities will be abundant throughout the development. The residential development parcels will have access to the trail system within or adjacent to the wash corridors through a planned localized trail system. It is anticipated that the homes abutting the wash corridors will include view fencing to take advantage of the views, natural desert vegetation and openness created by the wash corridors. The views and openness of the wash corridors will also create "eyes on the wash", improving perceived safety and comfort for users of the amenity.

Primary ingress and egress to Sunhaven will be from Grand Avenue along Lone Mountain Road, the major east/west arterial proposed through the property. In the future, additional access will be provided by others along Tillman Boulevard and 187th Avenue from the east. Collector roads will provide access to the individual development parcels throughout the community.

2. Land Use Plan

The Sunhaven land use plan achieves the following objectives:

- Provides a mix of land uses and a diversity of housing types;
- Promotes an appropriate distribution of residential units and densities to assure project diversity;
- Promotes a balanced distribution of parks and school facilities;
- Provides interconnectivity and linkages to neighborhoods and open spaces;
- Preserves open space for its visual, economic, hydrological, ecological and quality of life benefits;
- Locates residential units adjacent to open space amenities for direct access to recreational opportunities;
- Maximizes the project's land use compatibility with adjacent land uses;
- Improves the area-wide traffic circulation system; and
- Provides for design flexibility through standards and guidelines that allow for a creative and innovative project;

These planning objectives are achieved through a balanced PAD that includes a mix of land uses, including residential of varying densities and design, retail/commercial services, regional employment services, educational and public use facilities, open spaces and recreational facilities to create a diverse master planned community. The actual distribution of various lot sizes was determined based on project phasing to ensure a mix of lot sizes within each phase of development. The mix of lot sizes was determined by market experience and the projected market for future Sunhaven residents. Medium and high density parcels are located closer to transportation infrastructure and commercial services to support future multi-modal transportation opportunities along major roadways, and to provide an appropriate transition to lower densities. Neighborhood and community parks and pocket parks are evenly distributed throughout the community to provide close walking distance to a park facility and/or access to trail corridors from every residential development parcel within the community.

The Sunhaven PAD proposes an overall gross density of 3.8 dwelling units per acre, which is consistent with the density range designated in the Surprise General Plan for the property and is substantially lower than the 4.3 dwelling units per acre approved by the County. **Table 2**: *Density Table* (located at the end of this section) provides proposed information on each development parcel; including land use categories, parcel gross and net acreage, maximum density per parcel, and the projected target number of units per parcel for residential parcels. The table also includes proposed lot sizes for low density residential development parcels. **Figure 7**: *Land Use Master Plan* provides a graphic depiction of the proposed land uses identified within **Table 2**.

a. Residential

A variety of residential housing lot sizes and product types are proposed for the Sunhaven PAD. Homes will vary in character and size to target various

market segments and create a truly diverse community. For all residential development parcels, specific architectural guidelines will be established to ensure the highest quality design for all residential housing product, and establishment and compliance with the Single Family Residential Design Guidelines as defined within the PAD will be complied with on a project-wide basis.

Gross densities for single family residential parcels range from approximately 2.0 dwelling units per acre for single family parcels to 21 dwelling units per acre for the high density parcels. These densities are represented by the Low Density Residential (LDR, maximum 5 du/ac), Medium Density Residential (MDR, maximum 8 du/ac), and High Density Residential (HDR, maximum 21 du/ac) land use categories. Overall, a maximum unit count of 8,001 units is proposed for an overall gross project density of 3.8 dwelling units per acre. The overall residential densities are in compliance with the respective Low Density Residential (3-5 Du/Ac) and Suburban Residential (1-3 Du/Ac) land use categories as designated on the Surprise General Plan.

Table 2 identifies the projected lot size and target unit count for each residential development parcel within the LDR land use category. The total number of units is based on a projection of the number of lots that can reasonably be platted within each development parcel based on projected lot sizes and density requirements as defined within **Table 2.** Although 8,001 units is the maximum number of units allowed for the entire PAD, within each individual development parcel, the target unit count is just that - a target. The maximum unit count within any development parcel is determined by calculating the gross acreage of that development parcel by the maximum land use density listed in the table for that parcel. For example, development parcel A3 is 47 acres with a LDR (maximum 5 du/ac) land use density range. The target unit count is 142 units; however development unit A3 can develop up to 235 units by multiplying 47 acres by the maximum density of 5 units per acre as defined within **Table 2.** However, the total number of units for the project as a whole shall not exceed 8,001. To that end, if one development parcel develops below the target unit count, the remaining units can be transferred to other development parcels so long as the total unit count for the project as a whole does not exceed 8,001 and the maximum density allocated for any individual development parcel is not exceeded.

In the same manner, the projected lot size has been identified for each development parcel. As Sunhaven develops, the lot sizes can vary from parcel to parcel so long as the overall percentage of a particular lot size throughout the project does not exceed the projected overall percentage of that particular lot size as defined within **Section D** of this PAD by more than 3%. More detailed provisions for the unit count, percentage mix of various lot sizes and the flexibility provisions related to the location of various lot sizes on a parcel by parcel basis are defined within **Section D** of this PAD.

b. Commercial

Approximately 198 acres of commercial land use is proposed to serve the projected population as well as the surrounding area. Demand for basic retail and commercial services is anticipated within the area to support the planned residential population. The commercial centers have been located along the major arterial roadways to heighten retail exposure to the public, promote ease of access and minimize traffic impacts within the neighborhoods. In addition to vehicular, bicycle and pedestrian access along the major roadways, appropriate bicycle and pedestrian access and trail connections will be explored and determined at the time of site plan and subdivision plat.

There are two different types of commercial land uses anticipated within the PAD. The first is a major Town Center at the intersection of Lone Mountain Road and Tillman Boulevard. The Town Center is comprised of two development parcels and is anticipated to include a power center and/or major big box retail and/or wholesale businesses, as well as restaurants with outdoor dining. The Town Center area will serve the project's residential population as well as existing and future surrounding population within an approximate 10-mile radius. The commercial land use designation for the Town Center is consistent with the land use designation identified within the Surprise General Plan.

The second type of commercial land use is the community/neighborhood commercial centers. The community/neighborhood commercial centers are anticipated to serve the Sunhaven residents as well as surrounding development. Uses within the community/neighborhood commercial centers may include such uses as grocery, drug, dry cleaning, banking, restaurants, outdoor dining, video rental, nursery, etc. In compliance with established General Plan policy related to the appropriateness of commercial uses in residential districts, the community/neighborhood commercial centers are each less than 25 acres in size and are located along major arterial roadway alignments, deeming them consistent with General Plan policy.

c. Employment

Approximately 182 acres of mixed use employment is proposed along the western edge of the PAD. As growth continues to occur within the area, the need for employment land uses in the area is important to provide employment opportunities to minimize commute time for local residents. Employment land uses are proposed along the major arterial roadway running parallel to Grand Avenue, a proposed major thoroughfare running in a northwestern/southeastern direction. The employment land use is also immediately adjacent to the BNSF Railroad, providing potential opportunities for rail spur connections into the future development. The employment parcels may include uses such as major distribution centers, warehouses, office developments, research and development, light industrial uses, community college facilities or other similar educational facilities, etc. The employment land use areas are appropriately buffered from existing and

planned residential land uses, yet close enough for future residents to walk or bike to work.

d. Schools

The Sunhaven property is located within the Nadaburg Elementary School District. The project proposes three elementary school sites to respond to student population projections. The estimated school projections are based on the following calculations:

- LDR: .50 students per residential unit for K-8 students and .20 students per residential unit for 9-12 students.
- MDR: .35 students per residential unit for K-8 students and .10 students per residential unit for 9-12 students.
- HDR: .20 students per residential unit for K-8 students and .08 students per residential unit for 9-12 students.

The assumptions regarding student capacity of schools is 800 - 900 students for K-8 schools and 2,500 students for high schools. Based on the above calculations using the target residential units allowed per the PAD, the projected K-8 student population will be 3,046 students, which equates to a demand for three elementary schools. The projected number of high school students is 1,190, which translates to demand of less than half the capacity of a high school.

The Sunhaven PAD proposes to reserve land for three K-8 schools. The identified sites are evenly distributed to provide excellent vehicular and non-vehicular access to the overall community. The proposed schools are located adjacent to open space and improved park facilities, providing additional active and passive recreational opportunities as well as direct trail access to the school sites. Additionally, the school sites have been carefully located so that they are not within the Luke Air Force Auxiliary Field #1 65 Ldn noise contour lines as was proposed in the existing county zoning.

In addition to the school facilities as educational institutions, they also serve as community gathering points for the community. Through a future agreement with the school district, the school property will be available for various recreational activities and opportunities for residents to use and enjoy during non-school hours, including ball fields, playgrounds and meeting facilities. Additionally, each school facility is located immediately adjacent to a neighborhood or pocket park facility to further enhance the facilities as recreational and community focal points.

The developer has meet with the Nadaburg Elementary School District a number of times to discuss the project and the School District has supplied a letter of approval of this PAD proposal as it relates to the District. This letter is included in the Appendix.

e. Parks, Trails, Community Recreation and Open Space

Open space planning and recreational opportunities are an integral part of the Sunhaven development. The naturalized linear open space will include an interior pedestrian circulation system and greenbelt linkage to the neighborhood and adjacent parks from most surrounding parcels. An 8' wide meandering path system provides pedestrian and bike circulation through the major open space, looping through the site with connections between the future schools, the neighborhood park, community park and various pocket parks. The parks and trails have been designed with a general goal of an approximate ¼ mile walking distance from residential property to a park or open space or a trail leading to a park or open space. Visual surveillance will be provided along the trail corridors through a variety of strategies to ensure actual and perceived safety within these areas. Many of the subdivisions will be designed to provide front yards of homes facing the open spaces and trails, which will provide natural surveillance along the trails. Other trails are located adjacent to planned roadways, which also provide surveillance. Additionally, view fencing and lighting will be provided as appropriate in areas where washes are located between subdivisions, providing openness and visual surveillance within these open space and trail corridors.

The open space system will provide active and passive recreational areas as well as providing drainage and retention for the community. Generous landscaping and trees will shade the walks, amenities and buffer adjacent residential lots.

The facilities provided within specific parks and open space are programmed to complement each other and are evenly spaced around the community to provide convenient connectivity to all residences and minimize walking distances to trails and/or open spaces. A granular trail system will also be provided along select areas of the major washes to provide secondary linkages. Areas of disturbance along the trail will be buffered from adjacent streets or residential lots with low water use landscaping.

Figure 8, *Open Space, Trails and Amenities Master Plan,* is a conceptual view of the various open space areas, parks, community multi-use trails and other amenities proposed throughout the community.

A community park and a neighborhood park are proposed within the community. The community park is approximately 43 acres in size, and the neighborhood park is approximately 15 acres in size. Each park will provide community recreational opportunities that may include baseball/softball fields, soccer fields, basketball, playgrounds, multi-use trails, large group shade pavilions and parking lots. Amenities will be located to complement the adjacent schools and will be integrated with surrounding washes.

Three school sites are also proposed within the community totaling 43 acres. The three school sites will serve the projected population at build out and have been strategically located throughout the community to address project phasing as well as proximity to residential subdivisions. The schools are each

located immediately adjacent to either a neighborhood park or pocket park to provided additional open space and recreational benefit to students and residents. As mentioned in the School section above, various recreational activities and opportunities will be available within the school property for residents to use and enjoy during non-school hours, including ball fields, playgrounds and meeting facilities. This, coupled with the proximity of the adjacent neighborhood or pocket parks, make these facilities community activity centers and focal points within the development.

The community and neighborhood parks will have a formalized gathering area and great lawn for large community events. The sports fields will be in the lower retention areas adjacent to the main circulation system. Potential site furnishings include ramadas, picnic tables, drinking fountains, benches, grills, trash containers and pet waste collection dispensers.

Landscape will include functional turf areas with abundant trees for "meaningful shade" and low water use shrubs and groundcovers to buffer adjacent streets, parking, and residential parcels.

Access to the community and neighborhood parks will be provided via collector roads, local streets and the multi-use trail system. The multi-use trail system is a key component of the recreational open space throughout the community, linking all major recreational opportunities and development parcels.

See **Figure 9**, *Conceptual Community Park* and **Figure 10**, *Community Park Perspective* for the development concept of the phase 1 community park south of Lone Mountain Road.

In addition to the community park, neighborhood park and school facilities, a series of smaller pocket parks will be provided throughout the development adjacent to the individual residential development parcels to be specifically located and designed at the time of plat. The pocket parks are smaller, more localized parks designed to cater to the local residents within the adjacent subdivision(s). Parks primarily front onto streets and view lots with sidewalk connections through the linear park or adjoining residential streets. Installation of each pocket park will correspond with the adjacent development parcel(s).

Each pocket park will offer a range of amenities and activities that offer convenient facilities and access to all residents. Pocket parks will be individually themed with specific landscape and amenities for unique characters. Each park will become a shade "oasis" with strong tree massings and site furnishing to complement the intended use.

The parks within Sunhaven will be programmed and designed subsequent to PAD approval, which design will be subject to review by the City.

Conceptual locations of the pocket parks are demonstrated on **Figure 7**: *Land Use Master Plan* and **Figure 8**: *Open Space, Trails and Amenities Master Plan.* These pocket parks will be located throughout the development to

provide for access from all residential development parcels. An effort will be made to design the surrounding subdivisions to provide "eyes on the park" by orienting roads and homes to face the pocket parks to provide maximum exposure to the open space amenities and to provide the perception of safety to the users in the park. An example of a typical pocket park is shown in **Figure 11**, *Conceptual Pocket Park* and **Figures 12A and 12B**, *Pocket Park Perspectives*. The pocket parks will include a mix of active and passive amenities such as turf areas, tot lots, picnic areas, benches, grills, ramadas and trails.

Based upon the results of a cultural resources survey prepared for the site, there are no significant areas that are environmentally sensitive. Concurrent to this PAD review, an application has been submitted to the Army Corp of Engineers for the impacts on the delineated Section 404 washes. A significant amount of time and resources have been utilized to review and minimize potential impacts on these washes. As the plan demonstrates, the washes and wash corridors are an important and integral asset to the community. If fact, the washes were one of the most significant determinants in the land use plan for Sunhaven. As such, the PAD proposes to conserve the major wash corridors (totaling approximately 112 acres) throughout the property as open space that may be used as passive recreational opportunities and/or trail connections throughout the development. These corridors, in many cases, are anticipated to be improved to the extent necessary to accommodate the drainage plan for routing surface flows through the site. In general, these corridors will conform to the configuration identified on **Figure 8**, *Open Space, Trails and Amenities Master Plan*. The conceptual limits of the corridors will be refined through a detailed hydrologic analysis during the subdivision plat process. As many of the natural wash corridors will be maintained, the natural wildlife corridors within these areas will also be maintained.

All arterial streets will include landscape tracts to create openness, enhance visual aesthetics and establish a design theme throughout the community. 15' wide average landscape tracts will be provided along all arterial streets within the community. This equates to approximately 19 acres of total landscape tract area along arterial streets.

At the time of subdivision design, various landscape tracts and open space/retention areas will be provided within each of the subdivisions. The specific acreage and locations will be determined at the time of subdivision plat for each subdivision as it is developed and platted. An estimate of the acreage for subdivision landscape tracts and retentions/open space areas for the entire project is 49 acres.

Between the community park, neighborhood park, pocket parks, schools, multi-use trail system, open space/wash corridors, street landscape tracts, subdivision tracts and open spaces, approximately 311 acres of active and passive open space will be provided within the PAD. In accordance with the City of Surprise Zoning Ordinance and various General Plan policies guidelines, the Sunhaven PAD exceeds the parks and open space requirements. The Zoning Ordinance requires at least 7% of the gross

project areas to be set aside for public and/or private open space and recreational use. Additionally, the Single Family Residential Design Guidelines require 10% of the residential acreage to be designated as open space. The Sunhaven PAD proposes 15% open space per the gross PAD area and 22% open space per the net residential acreage, exceeding both standards defined above.

The General Plan includes various policy guidelines for parks and open spaces, with the most restrictive being a standard of 6 acres per 1,000 population for active and passive park facilities and an additional 6 acres per 1,000 population for open space. It should be noted that the General Plan expressly indicates that school facilities are included in the calculation for park facilities (Objective 4.5.4, Policy 1) as they provide a substantial amount of recreational open space amenities and community benefit, particularly when sited adjacent to additional shared park facilities. The developer intends to enter into a joint use agreement with the school district for the school and adjacent park facilities as park sites are located immediately adjacent to each proposed school.

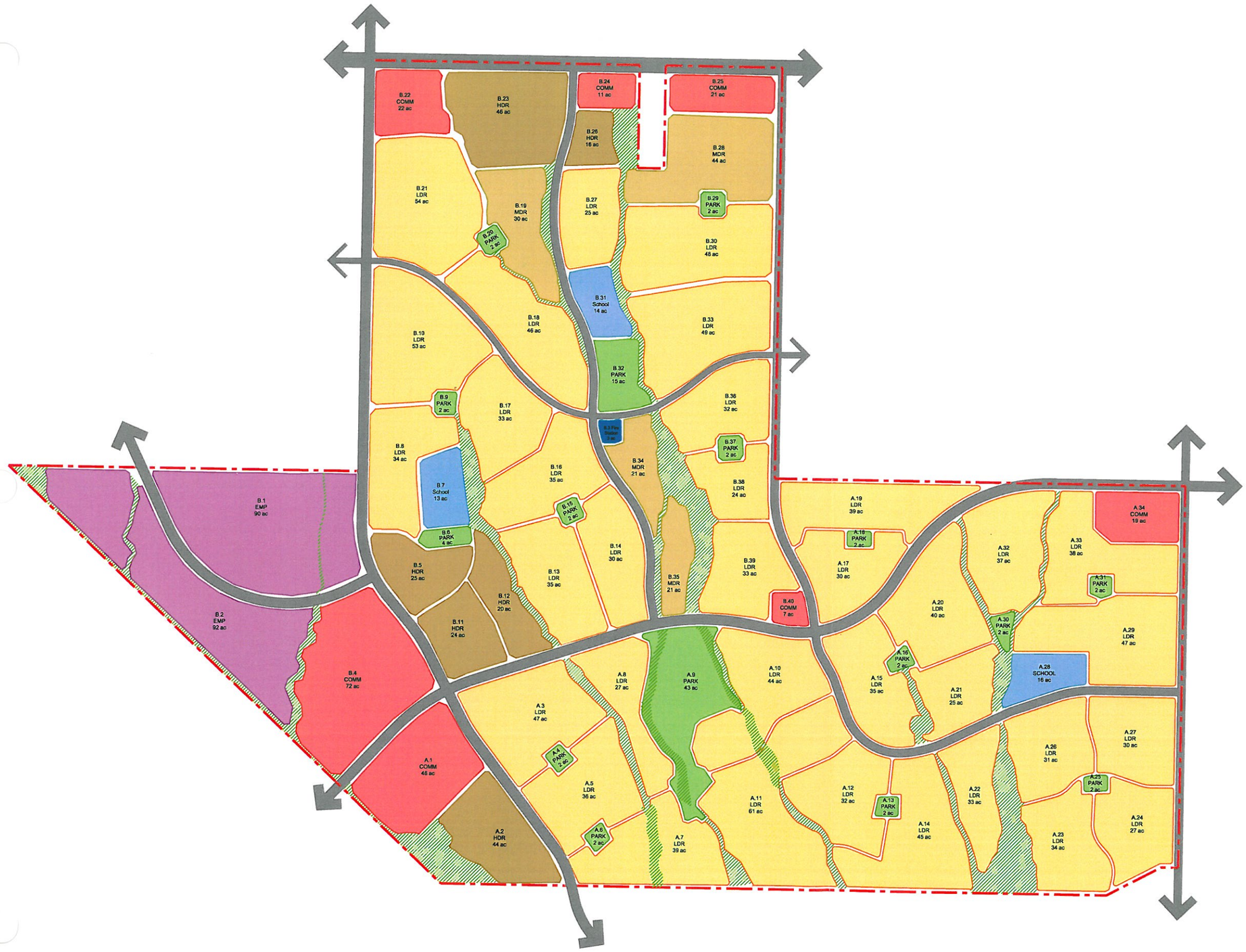
Using the 6 acre per 1,000 population standard for parks and open space, the requirement is 128 acres of parks and recreational facilities and 128 acres of open space. The Sunhaven PAD proposes 131 acres of parks and recreational facilities and 180 acres of open space, exceeding both the standards identified above. A breakdown of the various open spaces, acres and percentage of total open space for the project as a whole and for the net residential acreage is provided in **Table 1** below. This represents approximately 15% of the total gross area of the project and 22% of the net residential acreage of the project as discussed above. This substantially exceeds all adopted Surprise parks and open space requirements.

Table 1: Projected Open Space

Projected Open Space		
Open Space Type	Acres	% Total
Neighborhood Parks	58	19%
Pocket Parks / Trails	30	10%
Wash Corridors	112	36%
Arterial Street Landscape Tracts	19	6%
Subdivision Tracts and Open Space	49	16%
Schools	43	14%
Total Open Space in ac.	**311**	**100%**
% Gross Project Areas	**2,116**	**15%**
% Net Residential Acreage	**1,434**	**22%**

f. Fire Station

The developer has met with the City of Surprise Fire Department to determine the need for a fire department facility within the development. In coordination with the Fire Department, a three gross acre parcel of land has been identified for a future fire station. The location of the future fire station has been strategically determined within the transportation network to provide quick and easy access to all areas within the development as well as excellent access to surrounding property.



Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 7
Land Use Master Plan

LEGEND

- Low Density Residential (5 du/ac)
- Medium Density Residential (8 du/ac)
- High Density Residential (21 du/ac)
- Commercial
- Park/Open Space
- Multi Use/ Employment
- Fire Station
- School
- Wash Corridors
- Arterial & Collector Street Right of Way
- Property Boundary

Parcel Label:

Phase.Parcel Number
Land Use Designation
Gross Acreage

NORTH

Not To Scale

Date: 05-12-05
Drawn By: MR/DM
Revised: 02-28-07

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Table 2: Land Use, Density and Intensity Table

Parcel Number	Land Use Description	Gross Acreage	Net Acreage	Land Use Maximum Density (du/ac)	Target Unit Count	Proposed Lot Sizes
A1	COMM	46	36	-	-	-
A2	HDR	44	28	21	424	HDR
A3	LDR	47	37	5	142	63'X125'
A4	PARK	2	1	-	-	
A5	LDR	36	30	5	170	53'X115'
A6	PARK	2	1	-	-	
A7	LDR	39	33	5	123	63'X125'
A8	LDR	27	21	5	66	75'X130'
A9	PARK	43	36	-	-	
A10	LDR	44	37	5	164	53'X115'
A11	LDR	61	53	5	189	63'X125'
A12	LDR	32	28	5	91	75'X130'
A13	PARK	2	1	-	-	
A14	LDR	45	38	5	196	53'X115'
A15	LDR	35	26	5	131	53'X115'
A16	PARK	2	2	-	-	
A17	LDR	30	23	5	126	53'X115'
A18	PARK	2	1	-	-	
A19	LDR	39	29	5	129	63'X125'
A20	LDR	40	33	5	119	63'X125'
A21	LDR	25	19	5	77	63'X125'
A22	LDR	33	19	5	55	75'X130'
A23	LDR	34	25	5	85	75'X130'
A24	LDR	27	23	5	77	75'X130'
A25	PARK	2	1	-	-	
A26	LDR	31	25	5	140	53'X115'
A27	LDR	30	25	5	137	53'X115'
A28	SCHOOL	16	12	-	-	
A29	LDR	47	40	5	164	63'X125'
A30	PARK	2	2	-	-	
A31	PARK	2	1	-	-	
A32	LDR	37	30	5	91	75'X130'
A33	LDR	38	32	5	160	53'X115'
A34	COMM	19	14	-	-	
Subtotal		**963**	**762**		**3,053**	

Table 2: Land Use, Density and Intensity Table

Parcel Number	Land Use Description	Gross Acreage	Net Acreage	Land Use Maximum Density (du/ac)	Target Unit Count	Proposed Lot Sizes
B1	EMP	90	83	-	-	-
B2	EMP	92	70	-	-	-
B3	PUBLIC USE	3	2	-	-	-
B4	COMM	72	60		-	-
B5	HDR	25	21	21	466	HDR
B6	PARK	4	3	5	-	-
B7	SCHOOL	13	12		-	-
B8	LDR	34	32	5	140	63'x120'
B9	PARK	2	2		-	-
B10	LDR	53	49	5	187	75'x125'
B11	HDR	24	21	21	422	HDR
B12	HDR	20	16	21	358	HDR
B13	LDR	35	32	5	123	50'X115'
B14	LDR	30	28	5	99	58'x120'
B15	PARK	2	2		-	-
B16	LDR	35	32	5	127	68'x125'
B17	LDR	33	28	5	138	53'x115'
B18	LDR	46	39	5	149	53'x115'
B19	MDR	30	22	8	180	MDR
B20	PARK	2	2		-	-
B21	LDR	54	51	5	175	63'x120'
B22	COMM	22	19		-	-
B23	HDR	46	38	21	831	HDR
B24	COMM	11	8		-	-
B25	COMM	21	18		-	-
B26	HDR	16	11	21	284	HDR
B27	LDR	25	23	5	88	68'x125'
B28	MDR	44	42	8	262	MDR
B29	PARK	2	2		-	-
B30	LDR	48	43	5	155	75'x125'
B31	SCHOOL	14	12		-	-
B32	PARK	15	12		-	-
B33	LDR	49	45	5	197	58'x120'
B34	MDR	21	15	8	142	MDR
B35	MDR	21	11	8	127	MDR
B36	LDR	32	28	5	109	80'x125'
B37	PARK	2	2		-	-
B38	LDR	24	19	5	78	68'x125'
B39	LDR	33	27	5	110	50'x115'
B40	COMM	7	5		-	-
Subtotal		**1,153**	**987**		**4,948**	
Total		**2,116**	**1,749**	**3.78 du/ac**	**8,001**	

Table 3: Land Use Summary Table

Legend	Land Use	Acres	% Total	# Units
LDR	Low Density Residential	1,311	62%	4,505
MDR	Medium Density Residential	115	5%	710
HDR	High Density Residential	175	8%	2,786
COMM	Commercial	198	9%	0
SCHOOL	School	43	2%	0
PUBLIC USE	Fire Station	3	1%	0
EMP	Employment	182	9%	0
PARK	Park	89	4%	0
TOTAL		**2,116**	**100%**	**8,001**

TRAILS LEGEND

SYMBOL	DESCRIPTION	LENGTH
	5'-0" WIDE DETACHED & ATTACHED CONCRETE SIDEWALK	13.36 MILES
	8'-0" WIDE DETACHED CONCRETE SIDEWALK	4.80 MILES
	5'-0" TO 8'-0" CONCRETE OR GRANULAR TRAIL	12.90 MILES
	PROPERTY LINE	
	TRAILHEAD AND PARKING	
	PEDESTRIAN UNDERPASS	

PARK PROGRAMMING

SURPRAVEN HAS BEEN MASTER PLANNED TO OFFER ABUNDANT OPEN SPACE AND A WIDE VARIETY OF RECREATIONAL FACILITIES. AMENITIES ARE DISTRIBUTED THROUGHOUT THE PROJECT WITH NATURAL WASH CORRIDORS AND OPEN SPACE AREAS, ONE COMMUNITY PARK, A NEIGHBORHOOD PARK AND THE PARCEL POCKET PARKS.

COMMUNITY PARK

SURPRAVEN WILL INCLUDE A COMMUNITY PARK AND LINEAR OPEN SPACE TRAIL SYSTEM THAT INTERCONNECTS PARCELS THROUGHOUT THE COMMUNITY. LINEAR PARKS AND ADDITIONAL OPEN SPACE WILL BE INSTALLED WITH CORRESPONDING PHASE OF DEVELOPMENT. THE COMMUNITY PARK AMENITIES MAY INCLUDE A RECREATION FACILITY, SWIMMING POOLS, MULTI AGE PLAY STRUCTURE, BASKETBALL, VOLLEYBALL, BASEBALL FIELDS, PICNIC AREAS AND PASSIVE PLAY TURF.

NEIGHBORHOOD PARK

THE LINEAR OPEN SPACE TRAIL SYSTEM WILL INTERCONNECT THE LARGER COMMUNITY PARK TO THE NEIGHBORHOOD PARK AND THE PARCELS BETWEEN. THE NEIGHBORHOOD PARK IS PLANNED ADJACENT TO THE NORTHERN SCHOOL SITE. THIS IS PLANNED AS A JOINT USE FACILITY TO BENEFIT BOTH THE SCHOOLS AND THE COMMUNITY AS A WHOLE. PLANNED AMENITIES ARE A MULTI AGE PLAY STRUCTURE, BASKETBALL, PICNIC AREAS AND A MULTI USE TURF PLAY FIELD FOR VARIOUS SPORTS AND ACTIVITIES.

PARCEL POCKET PARKS

PARCEL POCKET PARKS WITHIN THE COMMUNITY WILL TIE INTO THE OVERALL HIERARCHY OF THE NEIGHBORHOOD PARKS AND LINEAR OPEN SPACE FACILITIES. PARKS WILL BE DESIGNED TO INTEGRATE THE OVERALL RECREATION PRINCIPLES OF THE COMMUNITY. AMENITIES PLANNED WILL COMPLEMENT THE SURROUNDING HOME SITES AND PROVIDE A DIVERSE AMENITY PACKAGE HOLISTICALLY THROUGHOUT THE COMMUNITY. PARKS WILL BE CONSTRUCTED THROUGHOUT THE DEVELOPMENT PHASES / TIMES. ALL POCKET PARKS WILL BE MAINTAINED BY THE HOME OWNERS ASSOCIATION AS ESTABLISHED BY THE DEVELOPER.

LINEAR PARKS

LINEAR PARKS WILL PROVIDE A PEDESTRIAN CONNECTION THROUGH THE COMMUNITY TO PARCEL POCKET PARKS, THE FUTURE SCHOOLS, AND NEIGHBORHOOD PARKS. THEY WILL FURTHER PROVIDE TREE SHADED SIDEWALKS, SEATING NODES WITH BENCHES AND PASSIVE RECREATIONAL OPEN SPACE AREAS FOR RECREATIONAL ACTIVITIES.

andersonbaron
landscape architecture

OPENSPACE, TRAILS AND AMENITIES PLAN
FIGURE 8

vollmer & ASSOCIATES

CONCEPTUAL COMMUNITY PARK

Figure 9

vollmer & ASSOCIATES

NEIGHBORHOOD PARK PERSPECTIVE
FIGURE 10

1/2 BASKETBALL COURT WITH EXTENDED WALK, SHADE TREES AND SITE FURNISHINGS FOR SPECTATORS

LAYOUT AND AMENITIES OF PARK SHOWN ARE CONCEPTUAL AND NOT REPRESENTITIVE OF ALL POCKET PARKS. FINAL LAYOUT AND AMENITIES ARE SUBJECT TO CHANGE WITH FINAL ENGINEERING AND DESIGN.

TYPICAL PLAYGROUND EQUIPMENT

SIDEWALK CONNECTIVITY TO SURROUNDING STREETS.

BENCH SEATING UNDER SHADE TREES.

SIDEYARD WALLS FOR ADJACENT RESIDENTIAL.

WALKWAY TO MEANDER THRU LANDSCAPE, HIGHLIGHTED WITH ACCENT PLANTING.

BENCH

SHADE RAMADA

PICNIC TABLE

TURF ACTIVITY AREA

INTERNAL WALK CONNECTION THRU PARK AND ADJACENT STREETS

TOT-LOT AND SHADE RAMADA WITH CIRCULAR WALK AND SHADE TREES SURROUNDING FACILITIES.

LARGE MULTI-USE TURF AREA (RETENTION)

vollmer & ASSOCIATES

CONCEPTUAL POCKET PARK
Figure 11

vollmer & ASSOCIATES

POCKET PARK PERSPECTIVE
Figure 12A

vollmer & ASSOCIATES

POCKET PARK PERSPECTIVE
Figure 12B

3. Circulation

The implementation of an efficient circulation system within the Sunhaven project is highly important to the overall quality of life for future residents. The efficient and safe movement of vehicular and non-vehicular traffic within and adjacent to the project will enhance the overall value of the community, promote mobility and reduce the potential for traffic conflicts. Balancing the project's land use plan with the transportation plan has been a key component in the planning of the Sunhaven design. The intent of the proposed circulation system is to create safe and efficient transportation opportunities for vehicular, bicycle, and pedestrian user groups.

The Sunhaven PAD makes significant improvements to the circulation system that was approved as part of the zoning in Maricopa County. In the existing land use plan, Sunhaven contemplated two major arterials at the interior of the site, Sunhaven Drive and Montgomery Road. Both of these streets were designed to "T" into the perimeter roads of Sunhaven at points that did not coincide with arterial street alignments, effectively creating a street pattern that did not consider the arterial street alignments in the Surprise General Plan.

By refining the existing land use plan with an eye on the circulation system, the proposed PAD vastly improves the transportation pattern in this area. The proposed circulation system creates a connection between Lone Mountain and the existing access to Grand Avenue, approximately at the 203rd Avenue alignment. This one change creates a transportation linkage between Grand Avenue and the interior of SPA 4. The circulation plan also includes the City's planned Tillman Boulevard, a major arterial that parallels Grand Avenue to provide a future connection by other parties between the future developments north and south of Sunhaven. The concept of Tillman Boulevard was approved as part of the Asante PAD and Sunhaven continues the implementation of this concept.

a. Vehicular

The Sunhaven project proposes the use of a public street system with standard cross sections in support of the parkway, arterial, collector and local street classification categories. **Figure 14**, *Roadway Cross Sections*, shows the proposed street cross sections of the various street classifications proposed for the development. Minor changes to the roadway cross sections can be made by the developer and/or the City so long as the pavement width and ultimate right-of-way width does not change. A Traffic Impact Study for the project has been prepared and is included in the Appendix. The report analyzes the impacts of the proposed land use plan and provides detailed analysis of the trip generation rates, traffic flow modeling results and a discussion of the relationship between on-site and off-site traffic.

Vehicular traffic to and from Sunhaven will be served by a variety of streets that will facilitate movement from residential areas, schools, parks, and commercial and employment parcels. The primary arterial street traffic pattern within Sunhaven has been designed to reflect the existing opportunities and constraints within the area. The Central Arizona Project

(CAP) canal is located approximately ½ mile to the south and the Grand Avenue/Railroad alignment is located along the southwestern edge of the property. Road crossings are restricted along both the CAP and the Grand Avenue alignment, so the primary arterial Roads have been designed to reflect these existing conditions. The applicant has worked closely with the City of Surprise Traffic Engineering Department to develop an efficient circulation pattern that works both for the Sunhaven project and the surrounding area.

The collector street system is designed to feed off of the arterial roads and provide direct access to the development parcels at the interior of the project. The collector roads provide an efficient circulation system while discouraging cut through traffic through residential neighborhoods. The collector streets are also designed to intersect the arterials near ½ mile and/or ¼ mile points between section line intersections to facilitate traffic signal timing if traffic signals are warranted under future traffic scenarios. See **Figure 13**: *Vehicle and Bicycle Circulation Plan* for a graphic depiction of the arterial and collector street system.

Roadways within the development are classified based on the distribution and intensity of the development according to the proposed land use plan, estimated daily traffic volumes and the importance to local and regional connectivity within the area. Portions of several streets along the perimeter of the property will be constructed in appropriate phases in accordance with City of Surprise roadway construction phasing requirements as part of the Sunhaven project. This includes half street improvements for Dove Valley Road and 187th Avenue, and portions of 203rd Avenue, 195th Avenue, and Lone Mountain Road in accordance with the alignments identified in **Figure 13**: *Vehicle and Bicycle Circulation Plan.* All roads entirely within the development will also be constructed in appropriate phases in accordance with City of Surprise roadway construction phasing requirements to the full ROW as part of the project.

The street cross sections for all arterial and collector streets to be constructed as part of this project are as follows:

- Lone Mountain Road: 136' full street right-of-way(1)
- Tillman Boulevard: 136' full street right-of-way
- Dove Valley Road: 100' half street right-of-way
- 187th Avenue: 55' half street right-of-way
- 195th Avenue: 55' half street right-of-way(2)
- 203rd Avenue: 68' half street right-of-way
- Collector Streets: 80'/105' full street right-of-way(3)
- Local Streets: 55' full street right-of-way

(1): Lone Mountain Road will include only half street improvements for approximately ½ mile from 187th Avenue westward;
(2): 195th Avenue will include full street improvements for approximately the first ¼ mile north of Lone Mountain Road.

(3): All collectors are high volume collectors with 105' full width ROW with the exception of the east/west collector connecting 203rd Avenue and 195th Avenue, which is a standard collector with an 80' full width ROW.

b. Bicycle and Pedestrian

Figure 13: *Vehicle and Bicycle Circulation Plan* and **Figure 14**: *Roadway Cross Sections* identify the planned vehicle and bicycle circulation within the Sunhaven community. All collector road alignments will be designed to accommodate bicycle circulation movements in addition to vehicular traffic movements by incorporating five feet wide on-street bicycle lanes to promote the use of bicycles as a viable means of mobility throughout the community. The Sunhaven PAD will incorporate detached sidewalks on all streets to promote pedestrian safety and comfort. However, due to pedestrian safety concerns, sidewalks will not be extended to cross the railroad tracks to connect to Grand Avenue. The sidewalks will terminate at an appropriate point near the south end of the commercial development on both sides of Lone Mountain Road north of the railroad tracks. This will ensure pedestrian access to the commercial properties, but will discourage pedestrians from crossing the railroad tracks and Grand Avenue at this location.

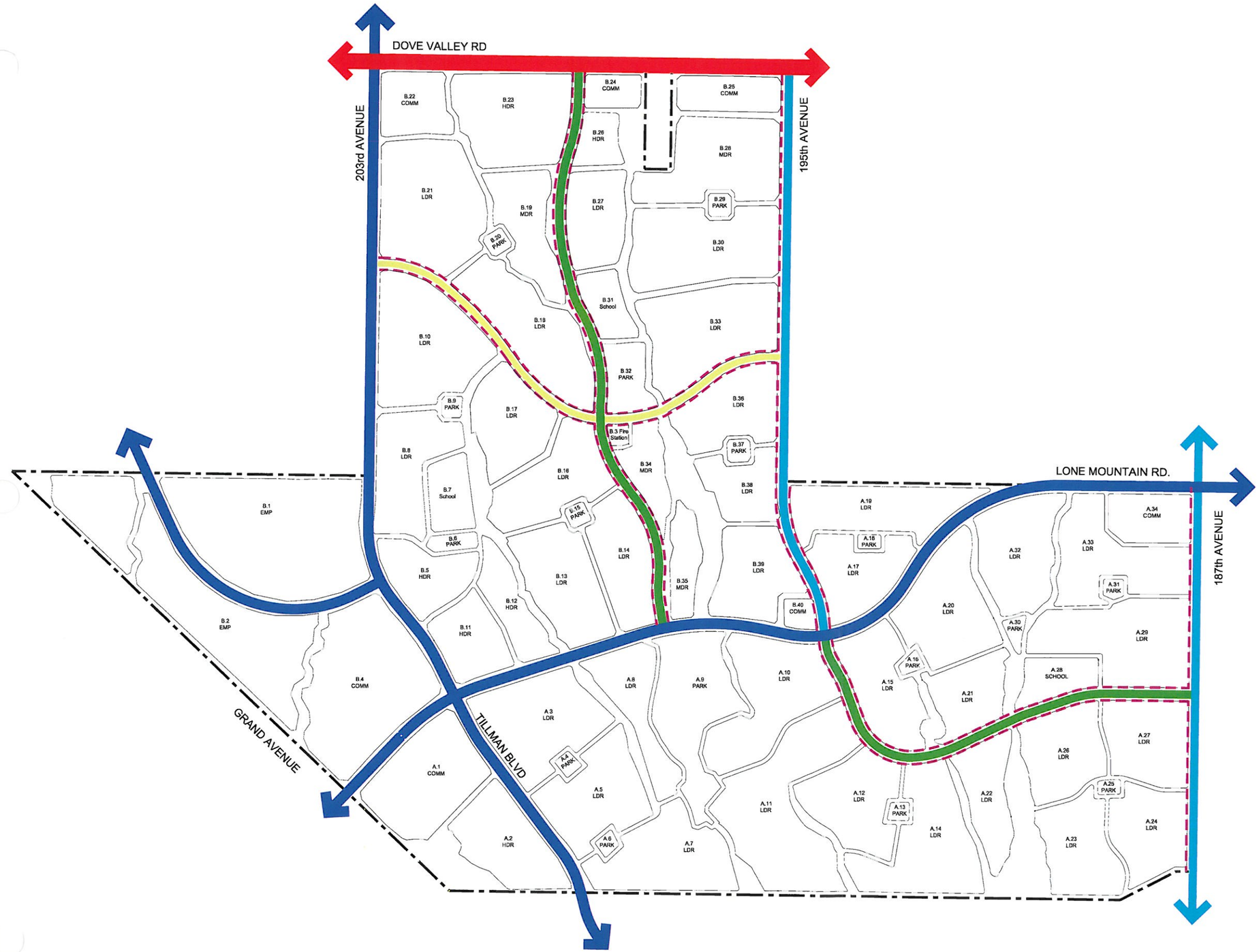
In addition to bicycle and pedestrian routes affiliated with the planned roadways, the Sunhaven PAD also proposes a comprehensive off-street multi-use trail system using a combination of concrete paths and natural surface trails. These routes are planned to provide a recreational amenity that connects to the various destinations. See **Figure 8**, *Open Space, Trails and Amenities Master Plan* for locations of the multi-use trails.

In addition to the major circulation elements as defined in this PAD, specifically the arterial and collector streets and the major trail systems, additional localized circulation elements will be incorporated into the individual site plans and subdivision plats as the project is developed. The intent is that all site plans and subdivisions will connect to the major circulation elements as defined within this PAD, and provide appropriate local circulation and connectivity to ensure a comprehensive circulation system for vehicles, bicycles and pedestrians throughout the community.

Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 13
Vehicle and Bicycle Circulation Plan



Legend

- Parkway (200' ROW)
- Major Arterial (136' ROW)
- Minor Arterial (110' ROW)
- High Volume Collector (105' ROW)
- Collector Road (80' ROW)
- Bicycle Lane

Date: 05-12-05
Drawn By: MR/DM
Revised:10/05/06

NORTH
Not To Scale

LVA Urban Design Studio L.L.C.

Master Planned Communities,
Land Planning,
Site Planning & Design
Environmental Analysis &
Landscape Design

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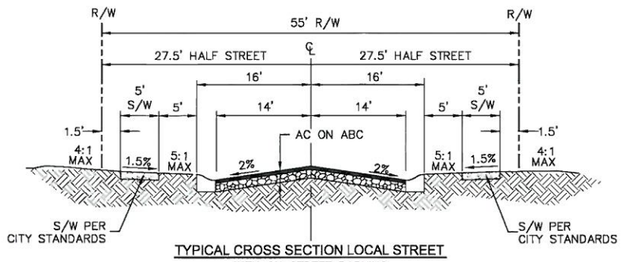
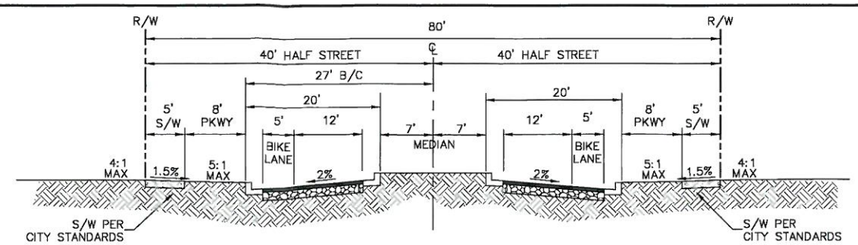
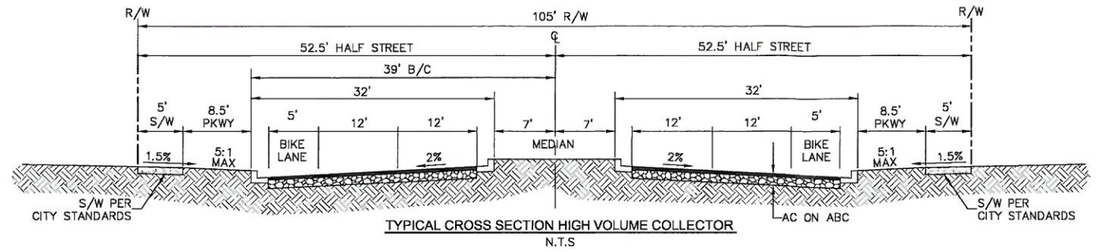


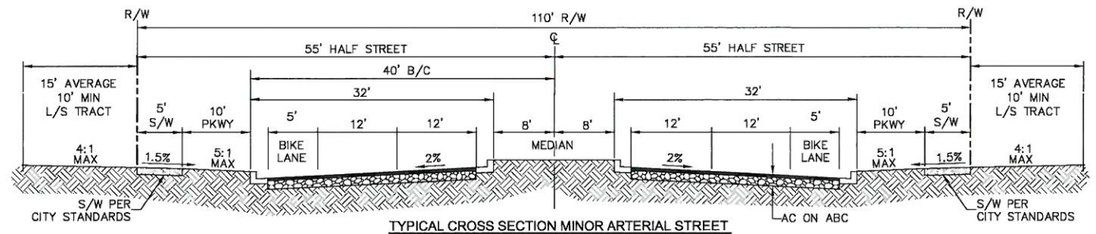
TYPICAL CROSS SECTION LOCAL STREET
WITH ON STREET PARKING
N.T.S



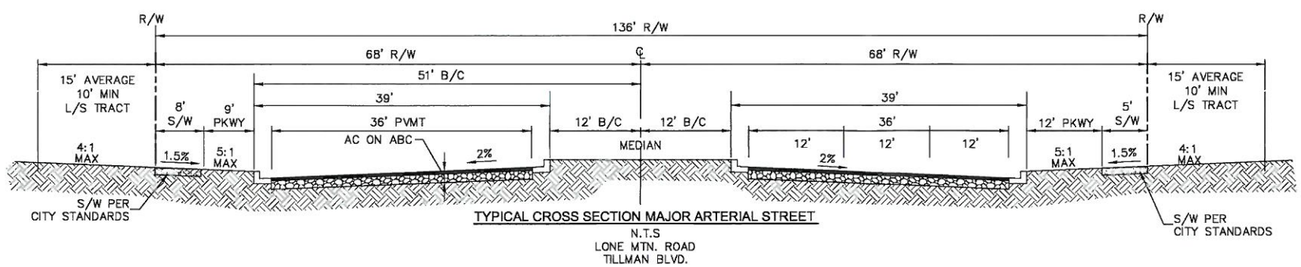
TYPICAL CROSS SECTION RESIDENTIAL COLLECTOR
MEDIAN AND BIKE LANE – NO PARKING
N.T.S



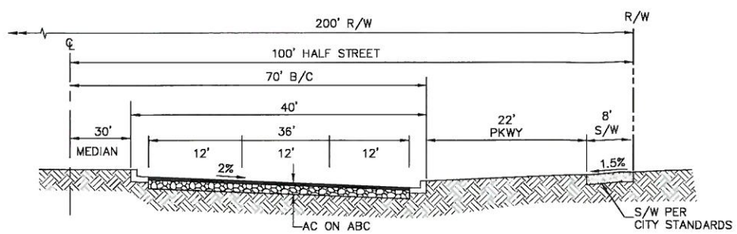
TYPICAL CROSS SECTION HIGH VOLUME COLLECTOR
N.T.S



TYPICAL CROSS SECTION MINOR ARTERIAL STREET
N.T.S



TYPICAL CROSS SECTION MAJOR ARTERIAL STREET
N.T.S
LONE MTN. ROAD
TILLMAN BLVD.



TYPICAL CROSS SECTION PARKWAY HALF STREET
N.T.S
DOVE VALLEY ROAD

Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 14
ROADWAY CROSS SECTIONS

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8605

Date: 05-12-05
Drawn By:
Revised:12-06-05

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4. Drainage

The drainage flows are primarily north to south through the property. The downstream outfall is a series of "overchutes" and drainage structures along the Central Arizona Project Canal south of this project. Several major drainage ways exist on the project. A Master Drainage Plan (see Appendix) has been submitted with this PAD that addresses the generation, conveyance, and retention of storm waters affecting this property.

The Sunhaven Project lies within the Wittmann Area Drainage Master Plan prepared by the Flood Control District of Maricopa County. The hydrologic model and methods found within the Wittmann ADMS will serve as the basis for the determination of flows to be conveyed within the natural wash corridors throughout the site.

There are many natural washes on the Sunhaven property. The US Army Corps of Engineers (USACE) has determined its jurisdictional limits under Section 404 of the Clean Water Act for the washes on this property. The 404 washes will form the basis of the drainage corridors through the project. Additional drainage areas outside of these washes will be provided as necessary to convey the 100-year, 6-hour event storm as defined by the Wittmann ADMS.

A retention volume equal to the 100-year, 2-hour storm will be required for the project. It will be necessary to drain these retention areas within 36 hours following the conclusion of the storm event. A series of regional retention / mixed-use areas will be provided across the project to meet the retention requirement. Multi-family residential developments and commercial projects will be required to construct and maintain their own on-site retention basins, sized and constructed at the time of development.

5. Landscape and Streetscape

The landscape master plan for Sunhaven is a lush desert landscape theme that relates to the natural washes and nearby mountain range. Thoughtful planning, architectural control, landscape design and recreational opportunities will establish the character of this development. Residential parcels, with generous exposure onto open space, will optimize the pedestrian relationships throughout the site.

a. Landscape Concepts and Plant Materials

The landscape will respond to the gentle sloping character of the land and incorporate specific principals that will become a signature to this project. Major entries and collector roads will incorporate formalized tree and shrub layouts. Arterial roads and open space tracts will have a more naturalized impression with alternating drifts of complementary plant varieties. Residential parcels will incorporate a neighborhood street tree program along all interior streets. Turf areas will be used in selected areas along high visibility areas, to functionally convey drainage while supporting the recreational opportunities of the Parks/Open Space Plan.

The vast majority of plant material used in common areas has been selected from the ADWR list. Two landscape zones have been created which utilize two (2) basic overlapping palettes to address streetscapes, parks, open space and residential development. Each palette consists of unique plant material to provide diverse character while maintaining an overall community theme.

Public Landscape Palette
The public landscape palette limits the varieties that can be used along common areas that include parks, streetscape, entries and washes. Efforts will be made to maintain the naturalized character along washes and linear parks, with an enhanced character along streetscape and recreational areas.

Private Landscape Palette
Private landscape areas include residential lots, interior commercial areas and select community facilities that have a higher intensity of use and limited solar exposure. It is intended that all landscape areas blend together with the lowest water use plants along streets and perimeter areas and an "oasis" character along concentrated use areas.

The majority of the native landscape materials found within the 404 wash corridors and the immediate slope banks will be maintained. Other important native landscape species will be evaluated for preservation in place and/or salvage on a case-by-case basis at the time of subdivision plat or site plan as the property is developed.

b. Streetscape

Interior roadways will have curb separated sidewalks to buffer pedestrians from traffic. Strong tree patterns will have alternating formal to random massings along wash and open space features.

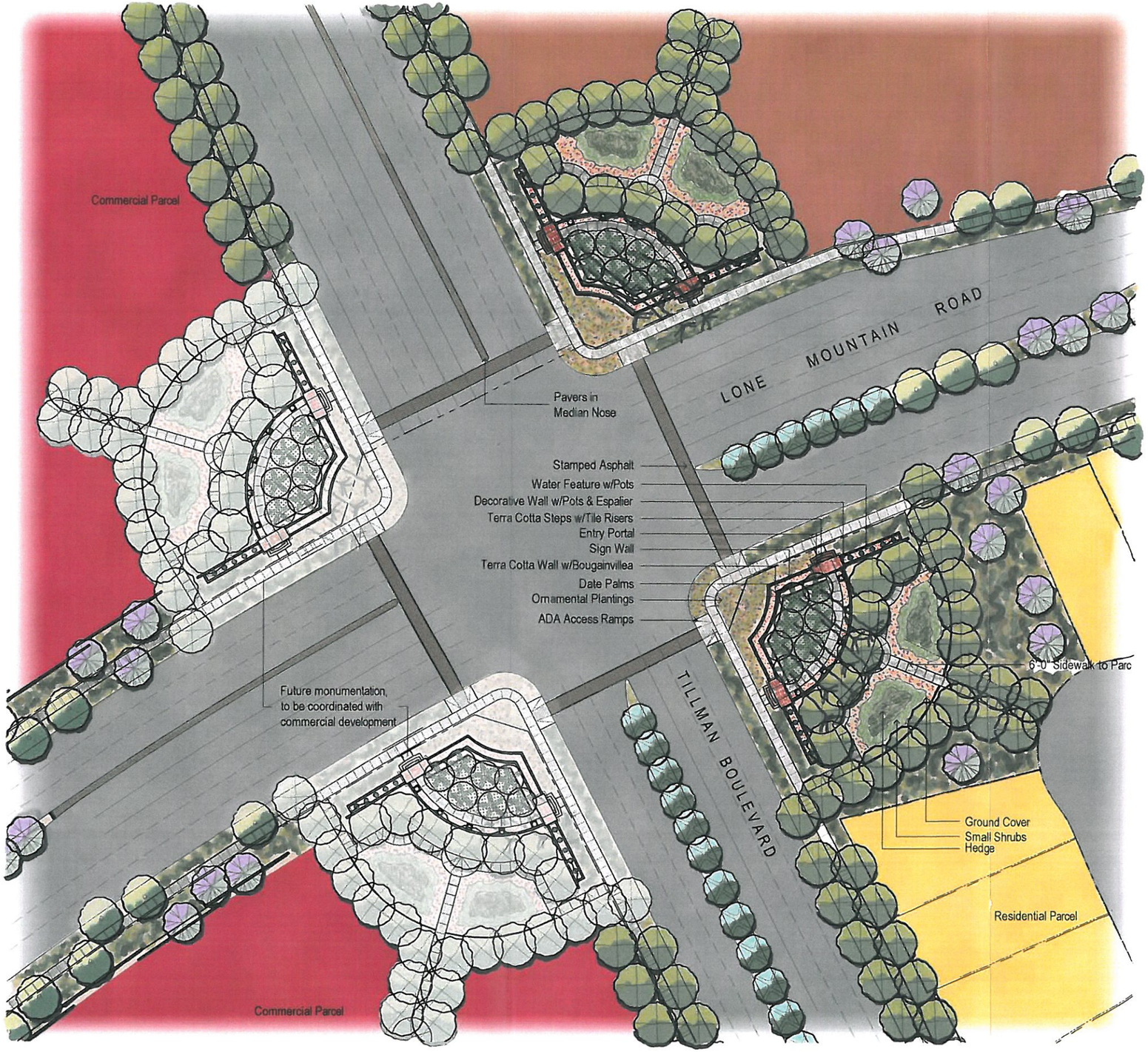
Shrubs will be planted in freeform "drifts" with alternating character and texture. Streets with concentrated development will have an enhanced character, while areas along open space will transition to a more native character to compliment undisturbed areas. Low water use flowering shrubs and groundcover will be selected for alternating seasons of display.

c. Entry Monuments, Signs and Perimeter Walls

Community walls and monumentation will incorporate rich materials and colors that distinguish Sunhaven with a recognizable traditional rural character. See **Figure 15**, *Interior Signage Monument*, **Figure 16**, *Signage Monument Perspective,* **Figure 17**, *Parcel Entry Feature* and **Figure 18**, *Thematic Wall Elements* for conceptual details on walls and entry monuments. A separate master comprehensive signage plan will be submitted to the City of Surprise for review and approval. This plan will include regulations for master development signage (temporary and permanent), individual site signage (temporary and permanent), subdivision signage, and marketing signage.

d. Water Conservation

Sunhaven will utilize several elements to achieve the desired water conservation goals. The landscape theme will emphasize the use of drought resistant plant species not only in roadway medians and shoulders, parks, and open space tracts but in the residential and commercial components of the project. A reclaimed water system is anticipated that will deliver reclaimed water within the project for irrigation of the parks and large open space tracts. The use of low flow plumbing fixtures within both public facilities and residential homes will be encouraged.



SUNHAVEN

INTERIOR SIGNAGE MONUMNET

FIGURE 15

date: 2.14.06
scale: 1"=20'-0"

element Homes

andersonbaron landscape architecture

SUNHAVEN

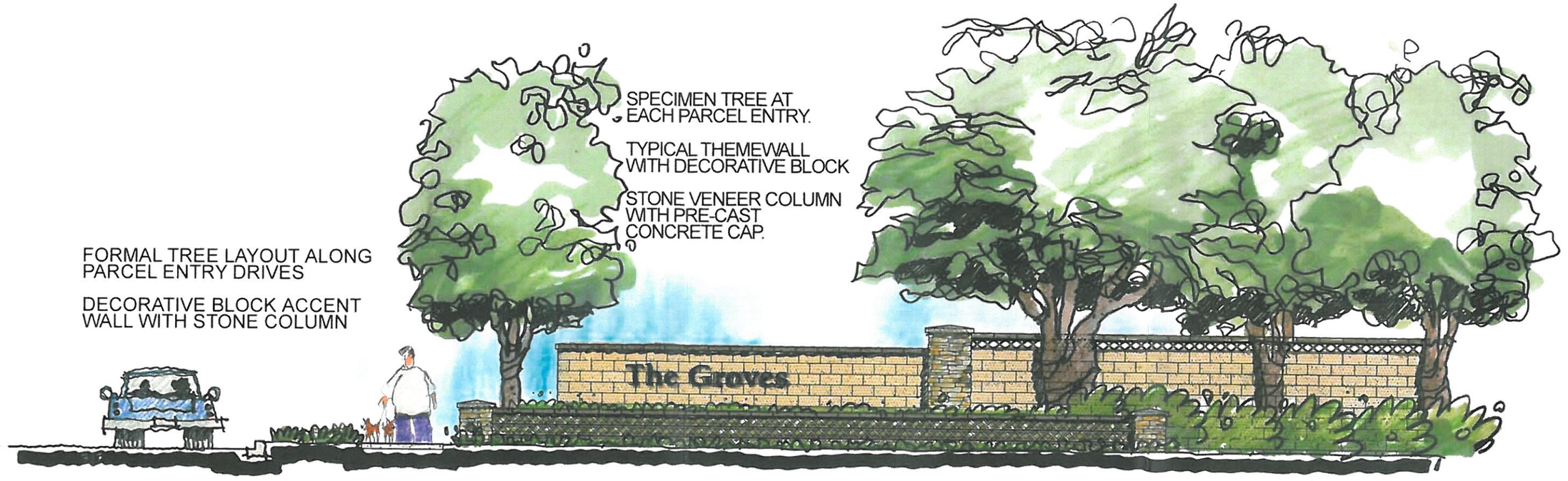
SIGNAGE MONUMENT PERSPECTIVE

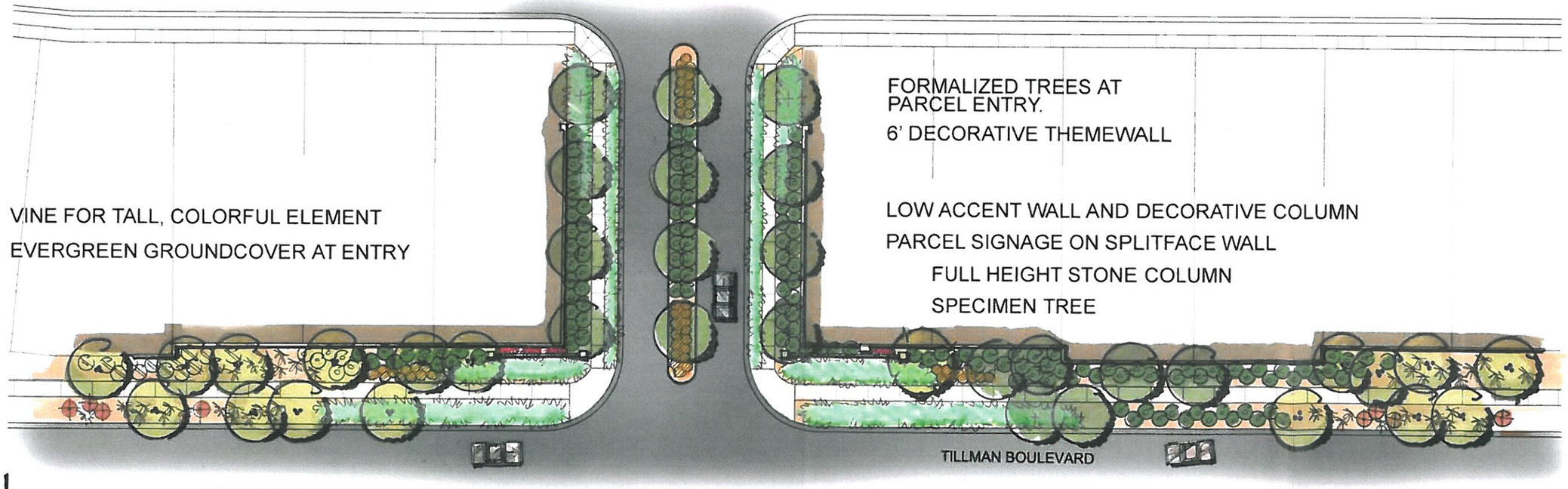
Figure 16

date: 12.07.05
scale: not to scale

element Homes

andersonbaron
landscape architecture

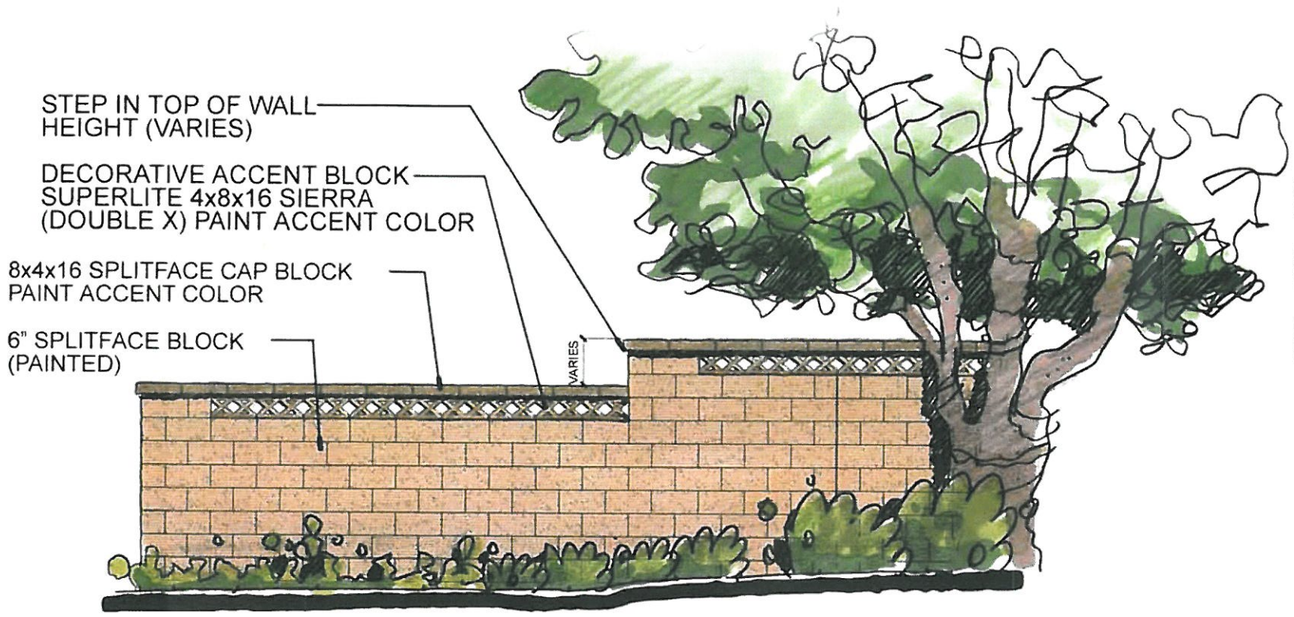




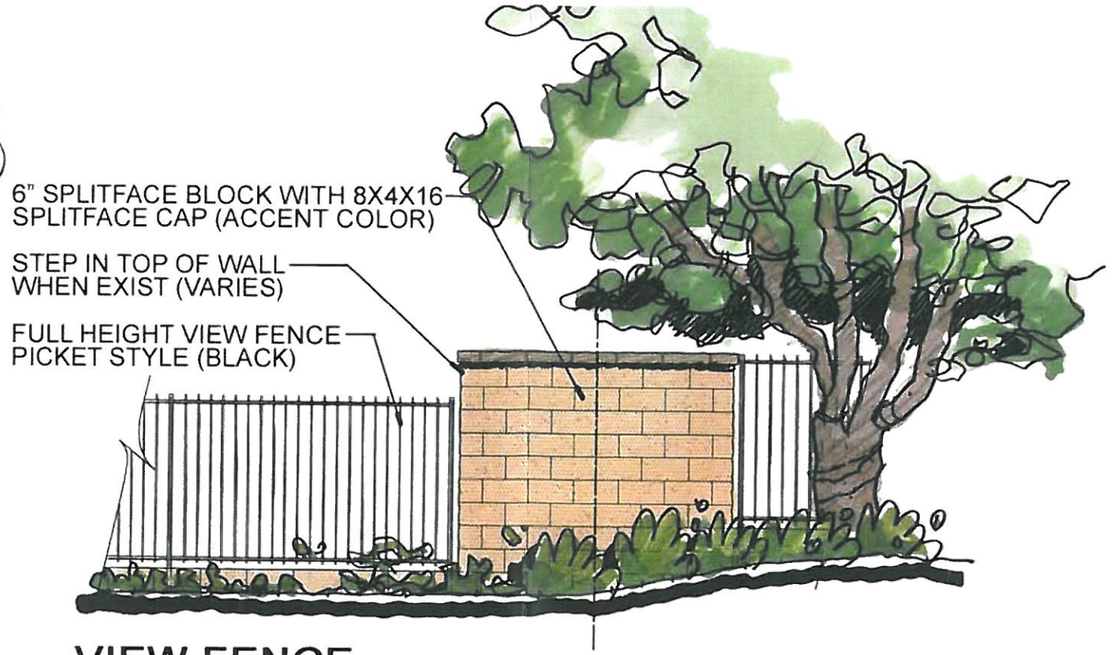
vollmer & ASSOCIATES

FREEFORM MASSINGS OF LOW WATER USE FLOWERING SHRUBS AND GROUNDCOVERS.

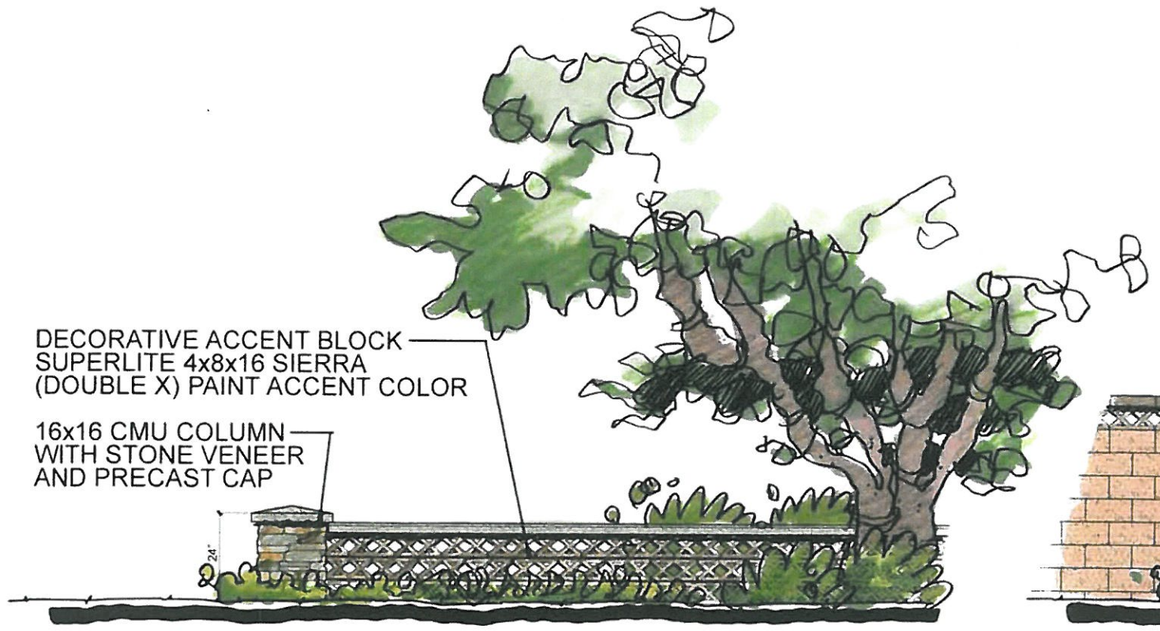
PARCEL ENTRY FEATURE
Figure 17



TYPICAL THEMEWALL



VIEW FENCE



LOW GARDEN WALL

DECORATIVE COLUMN AND OFFSET

vollmer & ASSOCIATES

THEMATIC WALL ELEMENTS
Figure 18

6. Utilities and Services

The public and franchise utilities discussed below will be constructed and installed underground in the public street right of way, in public utility easements (PUE) along and adjacent to some segments of the street right of way, and in additional easements along and across open space tracts as may be needed. PUEs will be provided primarily along the frontage of commercial parcels and across the front of the residential properties where these easements are required for the installation of facilities. When utilities are not located in corner lot side yards, it is anticipated that these easements will not be required.

a. Water Service

The majority of property lies within the future service area of the City of Surprise while approximately 320 acres west of 203rd Avenue is within the current service area of West End Water. That portion of the project lying within the future service area of the City of Surprise has been analyzed in conjunction with the City's Water Master Plan for SPA 4. Groundwater wells and water storage facilities consisting of two, 1.8 million gallon tanks will be required. Their construction may be phased as development of the project proceeds. The area of the project within the West End Water Service Area will be handled separately with that Company.

The water system for the Sunhaven project will be designed based upon supply from wells that will be constructed on the property. The property lies within Zones 8 and 9 of the City of Surprise's Water system. The West End Water Service Area will be set to similar Hydraulic Gradelines, subject to the approval of West End Water Company.

The City of Surprise guidelines require the construction of a minimum of two 1,500 gallon per minute wells for each section of land included in the development. Well service requirements have been estimated based upon meeting average day maximum month (1.7 times ADD) with at least one well in reserve. If a target value per well of 1,000 gallons per minute were used, a total of 6 wells would be required to service the property within the City of Surprise water service area. This would allow for 5 wells to meet the Average Day Maximum Month Demand with one well in reserve. The wells will be collected in a series of pipelines that will convey the water to the water plant in the eastern part of the property.

The development of the water systems will be in accordance with the City of Surprise development guidelines, the development guidelines of the West End Water Company, or as modified within the Water Master Plan (see **Appendix**) approved by the City of Surprise and the West End Water Company.

b. Wastewater Service

The property lies within SPA 4 of the sewer service area of the City of Surprise. A sewer collection service system and a wastewater treatment

plant located on the south end of the project is proposed to serve the development. It is anticipated that the 3.3 MGD treatment facility needed to serve the project may be constructed in one or more phases. While the City plans to eventually construct a regional wastewater treatment plant to service the entire area of SPA 4, it can not be constructed in the time frame necessary to serve this project.

A sewer collection system will be designed and constructed to serve the needs of 8,001 units for Sunhaven. The wastewater generation rate per capita of 100 gallons per day has been used as a basis for sizing the system. Based upon a population estimate of 3.2 persons for low density residential dwelling units and 2.0 persons for medium/high density residential units, a total population of 21,362 is expected. In addition, a wastewater contribution factor of 2,500 gallons was estimated for each acre of proposed commercial and employment development. This density of dwelling units over the property is based upon the City of Surprise General Plan for the area and the levels proposed by the developer within the Sunhaven Planned Area Development document. The facilities will be sized based upon the peak flow.

The high quality effluent from the wastewater treatment plant will be used as irrigation water for the parks and large open space tracts within the project and also to recharge underground aquifers.

A Wastewater Master Plan (See **Appendix**) has been submitted to the City of Surprise along with this PAD document. This Master Plan will utilize City of Surprise, Maricopa County, and State of Arizona criteria to determine flow rates and size the required infrastructure.

c. Electric Service

Electric service will be provided by Arizona Public Service. Existing electric facilities consist of an overhead, three-phase, 69 KV electric line with a single three-phase, 12 KV electric line under, hung on common poles. This pole line is located along the West Side of Grand Avenue. There are also overhead, three-phase, 12 KV distribution lines extending north across Grand Avenue, which parallel the easterly side of 203rd Avenue. The feed for the 12 KV facilities is the Deer Valley substation located approximately 6 miles south of the project site at Grand Ave. and Deer Valley Road.

Most of the capacity of the 12 KV line extending north along 203rd Avenue is utilized by the Chrysler Proving Ground. There is remaining capacity for approximately 200 residential units. The Morristown substation to the north of the site is almost at capacity and cannot be expected to be a source for Sunhaven. For the development of Sunhaven, an additional substation will need to be constructed. 12 KV lines would be extended from this site to serve the project.

d. Telephone Service

Telephone service can be provided by Qwest Communications. Existing underground fiber optic facilities are located along the West Side of Grand Avenue and are expected to be used to provide service.

Sunhaven will be served from the Circle City Exchange and the existing fiber optic facilities along Grand Avenue will be the source of service. Fiber optic will then be extended throughout the project.

e. Cable Service

Cox Communications is the franchise provider for CATV in this area however there are no Cox communication facilities in the immediate vicinity. The nearest existing facilities are approximately 8.5 miles south along Grand Avenue near the Loop 303 intersection. Extension from this location would be required in order for Cox Communications to serve Sunhaven.

f. Natural Gas Service

Natural Gas service will be provided by Southwest Gas Corporation. There is a 16 inch high pressure transmission gas main along the West Side of Grand Avenue. A 6-inch high-pressure line is tapped into the transmission line approximately 1700 northwest of the 203rd Avenue intersection with Grand Avenue and is anticipated to provide service.

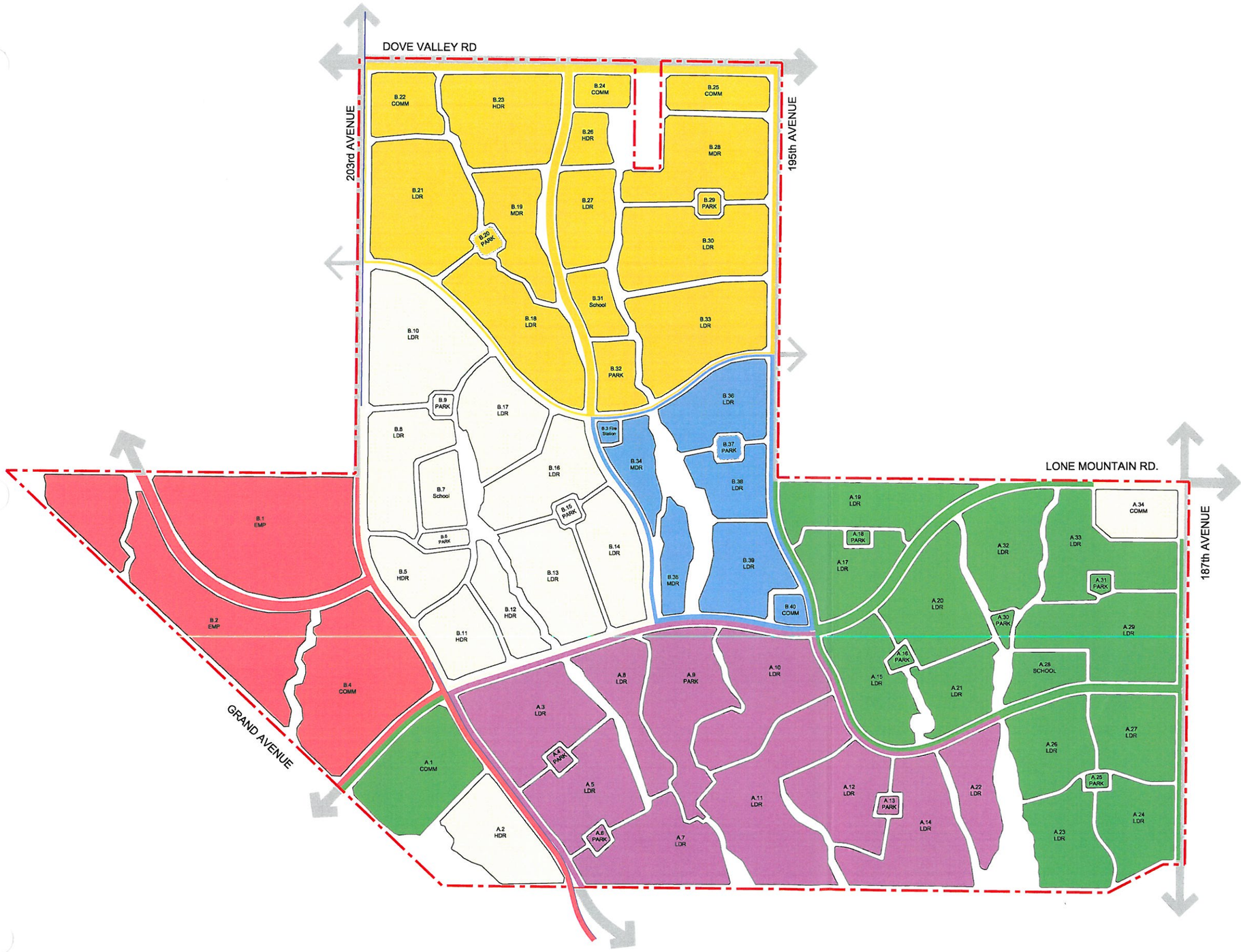
For service to the Sunhaven project, the existing 6-inch line on the West Side of Grand Avenue will need to be extended northeast across Grand Avenue and the BNSF Railroad right of way. Within the project, the 6 inch line will extend to several locations where the pressure and the pipe size will be reduced for distribution to end users.

7. Development Schedule and Phasing

Six development phases are proposed for the build-out of the Sunhaven Master Planned Community. **Figure 19**: *Development Phasing Plan* shows the location of the proposed project phasing. Infrastructure for each of the development phases will be accomplished in a manner consistent with the need for such infrastructure within each phase in accordance with City of Surprise infrastructure phasing requirements. The project phasing anticipates staging the project within six phases with each phase anticipated to occur at approximately two year intervals. The current development schedule is projected as follows:

- Phase 1 - 2007 through 2010
- Phase 2 - 2007 through 2010
- Phase 3 - 2011 through 2012
- Phase 4 – 2013 through 2014
- Phase 5 – 2015 through 2016
- Phase 6 – 2017 through 2019

It is estimated that the total project build out will take approximately 12 years. This estimate may vary depending upon the influence of various external factors such as overall market conditions and housing demand. Revisions and adjustments to the project phasing locations and/or timeline shall not constitute an amendment to the plan but will be an administrative modification.



Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 19
Development Phasing Plan

LEGEND

- Project Boundary
- Phase One
- Phase Two
- Phase Three
- Phase Four
- Phase Five
- Phase Six

Date: 06-02-05
Drawn By: KN/DM
Revised: 02/27/07

NORTH

Not To Scale

LVA Urban Design Studio L.L.C.

Master Planned Communities,
Land Planning,
Site Planning & Design
Environmental Analysis &
Landscape Design

7502 East Main Street
Scottsdale, Arizona 85251
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8. Management and Maintenance

a. Community Association Responsibility

A master community homeowners association (Master Association) will be created to manage all common open space facilities owned by the Master Association and govern the affairs of the Master Association through a formal governance structure to be established in the Master Associations' bylaws. In addition to common tracts owned by the Master Association, the Master Association will assume the maintenance responsibility for median landscaping and landscaping within the roadway easements, community entry and other facilities deeded to the Association. The purchasers of property in Sunhaven will automatically become members of the Master Association and will be required to pay annual dues for the operation and maintenance of community facilities owned by the Association. The dedication and acceptance process will coincide with the public approval of the facilities through the regulatory development review process. Once accepted, it will become the Association Board's responsibility to manage and maintain the facilities under the purview of the bylaws and project design review requirements.

b. Local Association Responsibility

Local neighborhood associations (Local Association) may be created to manage and maintain small tracts and/or private streets within individual or groups of subdivisions if warranted by subdivision design. Local Associations however, will not have the responsibility to maintain regional or community facilities that are immediately adjacent to the subdivision(s). Resident participation in a Local Association will not negate their mandatory participation in the Master Association.

9. General Plan Policy Checklist

1. LAND USE

A. Locate higher density/intense residential land uses & transportation dependent uses near major roadway corridors to promote an efficient transportation system. **Page 27**

Response: Higher density residential development parcels are adjacent to or within close walking distance to arterial roadways.

B. Does the project involve cluster development? Encourage clustering for preservation of natural open space within residential neighborhoods. **Page 28**

Response: The project may include cluster development within the MDR parcels. Additionally, the project proposes to conserve a significant amount of natural open space.

C. Is the project located near any of the following areas - Daimler-Chrysler, Volvo, NW Valley Landfill, White Tank Mountains, Surprise Center, Luke AFB? If so, analyze policies that pertain to each individual location **(see pages, 28, 29, 30, 96, 111, 146)**

Response: The project is immediately south of the Daimler-Chrysler proving grounds wherein adequate buffering is provided to protect single family residential development from impacts of the proving grounds. Conversely, the proposed Sunhaven PAD will not adversely affect the operations of the proving grounds because the land uses are similar to what is already entitled within the County with the exception that the proposed PAD reduces overall density by approximately 11%. Further, the City has recently approved a Major General Plan Amendment for the proving grounds property as a residentially-based master planned community similar to Sunhaven, making the uses even more compatible.

D. Is the project located near a designated "Gateway Area"? Is it a mixed use? **Page 28**

Response: The project is not near a designated Gateway Area.

E. Discourage strip commercial developments and free standing pads except where expressly permitted. **Page 29**

Response: The project does not proposed strip commercial development. Freestanding pads are allowed within the commercial development parcels in conformance with the proposed development standards.

F. Use building envelopes that provide for natural buffers between buildings in order to protect sensitive landforms, vegetation and/or wildlife corridors. **Page 28**

Response: There are no significant landforms on the property. Based on the cultural resources survey prepared for the property, there are no significant areas that are environmentally sensitive except for the delineated 404 wash corridors. As the plan demonstrates, the washes and wash corridors are an important and integral asset to the community and have been one of the significant determinants in the land use plan. The project proposes to conserve significant wash corridors, including important vegetation and wildlife corridors within those areas. The preservation in place and/or salvage of other important native vegetation throughout the site will be reviewed on a case-by-case basis as site plans and subdivision plats are prepared.

G. Locate regionally oriented retail and service uses or other high intensity employment uses along major roadways with proper access, transitioning to lower intensity uses buffered adequately from residential uses. **Page 29**

Response: All commercial and employment parcels are directly accessible from adjacent arterial roadways in order to maximize exposure and

access while providing adequate buffers from local residential neighborhoods.

H. Are planned trails and functional open space indicated as neighborhood connections? **Page 29**

Response: Yes, the plan includes multiple trail connections and open space corridors to connect residential development parcels to other land uses as well as recreational amenities throughout the community.

2. TRANSPORTATION:

A. Provide service coordination that can ensure that transportation services connect as efficiently as possible, minimizing wait times. **Page 62**

Response: The traffic impact analysis submitted as part of this PAD analyzes traffic impacts and concludes that the street layout is efficient. Additionally, the applicant has worked closely with City of Surprise transportation staff on the proposed roadway alignments for the project.

B. Bicycle & pedestrian facilities should be incorporated into the planning, design and operation of transportation systems. **Page 62**

Response: Bicycle lanes will be provided as shown on the street sections included in this PAD. Pedestrian sidewalks will be provided on all streets within the community. Additional, numerous multi-use trails will be provided for both pedestrian and bicycle user groups.

C. Require pedestrian circulation plans to be submitted, along with vehicular circulation plans, as part of the review process. **Page 63**

Response: The PAD includes street cross sections indicating pedestrian sidewalk locations and widths throughout the development. Additionally, an Open Space Master Plan is provided which includes additional pedestrian sidewalks and trails throughout the development.

D. Encourage walkways near roads, but separate them from the curb whenever possible or provide a bike lane as a buffer. **Page 63**

Response: Walkways and bicycle lanes will be provided as shown on the street sections included in this PAD. All sidewalks will be separated from the curb.

E. Provide adequate bicycle storage at all major employment centers, commercial centers, and transit centers. **Page 63**

Response: Bicycle storage facilities will be provided at major commercial and employment centers.

F. Promote the use of traffic calming techniques in pedestrian areas to make vehicular speed limits self-enforcing. All traffic calming

techniques will be evaluated by and will require the approval of the City Engineer. **Page 64**

Response: The roadway network has been designed with vehicle travel speeds in mind. At the time of subdivision platting, local roads will also be designed to address vehicle speeds so as not to require additional "after the fact" traffic calming. Techniques may include ensuring street length is appropriate to discourage speeding, avoiding long through movements and by providing curves or other natural traffic calming measures.

3. ECONOMIC DEVELOPMENT:

A. Avoid placing non-compatible uses adjacent to designated employment and commercial areas that will make future development of these uses difficult/unappealing (e.g. single-family homes abutting a business park without buffering). **Page 94**

Response: Employment and major commercial uses are properly located and therefore are adequately buffered from residential areas. Additionally, the proposed development standards provide adequate setbacks and landscape buffers to further protect residential neighborhoods.

B. Maintain employment and commercial related land uses as prescribed in each Special Planning Area. **Page 96**

Response: Commercial and employment land uses are consistent with the Special Planning Area.

4. HOUSING:

A. Locate residential areas that are appropriately sited and protected from incompatible uses yet integrated through both pedestrian and vehicular linkages. Appropriately site these areas with minimal adverse impact on the natural environment. **Page 99**

Response: The overall land use plan, circulation plan, open space system and development standards have been very well thought out as it relates to land use compatibility and circulation issues, while minimizing impacts to the natural environment.

B. New developments within or next to existing residential areas should enhance or contribute to the character or qualities of that area. **Page 99**

Response: There are no existing residential developments adjacent to this project; however, the plan is sensitive to future surrounding developments as it relates to perimeter buffer areas.

C. Encourage developers to cooperate and communicate with residents and homeowners' associations during the development review process prior

to the official public hearings. **Page 99** (Refer to Citizen Participation Ordinance).

Response: While there are no existing residential properties adjacent to the site, notification to adjacent landowners has occurred per the Community Outreach Process Guidelines and the results of the notification and subsequent public meeting are provided in the Community Outreach Summary included with the revised PAD submittal.

D. Housing developments should be adequately provided with community facilities and services. Desirable community facilities and services include: parks with tot lots, benches, larger retention areas with ramadas, shade trees, etc. **Page 99**

Response: The project will include extensive community facilities, including a community park, a neighborhood park, numerous pocket parks, trails, natural open spaces and school facilities.

E. Promote the following qualities: durable materials in construction that are compatible with the area's climatic and energy factors, encourage exterior detail and positive site-design features, utilization of open spaces, creation of a pedestrian environment, buffers between density transitions, minimize through or overflow vehicular traffic. **Page 99**

Response: Durable materials and quality design features will be used throughout the development, both in the overall community design and in the specific home and commercial product provided by builders.

5. OPEN SPACE AND RECREATION:

A. Define a park as a tract of land that contains a mix of active and passive recreation facilities potentially including tot lots, defined and improved play field and/or sport courts areas, and picnic/seating/shade areas that are landscaped/hardscaped in a pleasing manner. Parks should generally be located in the center of their service area and can be developed jointly with schools & serve as retention basins for storm water. **Page 109**

Response: Extensive parks and open space facilities are provided throughout the community. The details related to design and amenities are provided within the PAD narrative and graphic files.

B. Strive to achieve an open space standard of six acres per 1000 residents. Establish a standard of six acres of parkland per 1000 population. **Pages 109 & 111**

Response: The Sunhaven Community will provide approximately 131 acres of parks and recreational areas, exceeding the current adopted standard of 128 acres in accordance with six acres per 1,000 population (total projected population of 21,362 residents). Sunhaven will also provide

approximately 180 acres of open space, exceeding the standard of 128 acres of open space per the above standard. The total acreage for open space and parks and recreational areas is 311 acres, approximately 15% of the total gross PAD area and 22% of the net residential acreage.

C. Review the Open Space and Recreation Element in the city's consideration of development proposals to determine the need for new parks and their requirements generated by the proposed project. **Page 109**

Response: The General Plan identifies 2 neighborhood parks within the project area. These are provided within the plan.

D. Increase the amount of park and open space identified in the city's development agreements to total 13 percent (equally divided between parks & open space areas) of the net project area. **Page 109**

Response: The total amount of parks and open space as a percentage of the total net residential area of the project is approximately 22%, almost double the goal of 13% goal as identified above.

E. Neighborhood or school parks proposed as an amenity in a subdivision shall be developed in conjunction with the first phase. **Page 110**

Response: Numerous parks will be provided throughout the community. Construction of the parks are identified in the Phasing Plan provided within the PAD document.

F. Utilize natural washes as part of the trail system. Protect 10% slope areas and Palo Verde-Saguaro vegetation areas as open space. **Page 111**

Response: An extensive trail system will be provided throughout the community, including trails within the wash corridors. Other than various wash banks, there are no slopes in excess of 10% on the property, nor is there any extensive Palo-Verde or Saguaro vegetation on the property.

G. Protect ridge/crestline, steep-sloped (more that 10%) and Palo Verde-Saguaro vegetation areas as open space through the use of density transfer or purchase of development rights, acquisition, donation, or other acceptable methods. **Page 111**

Response: There are no ridges/crestlines or steep slopes on the property.

H. Discourage development within 100-year floodplains, encourage dedication of a continuous 25 foot min. setback on both sides. Development within 100 feet of floodplains will require a hydrology study to determine setbacks greater than 25 feet. **Page 111**

Response: The project will not develop within a 100-year floodplain without drainage modifications approved by the City of Surprise. Adequate buffering will be provided at the time of subdivision plat.

I. Ensure that natural drainage channels are protected and used as a connected trails system to link open space, parks, schools etc. **Page 111**

Response: Natural drainage channels will be protected and used as a connected trails system to link open spaces, parks, schools and other amenities within the development.

J. Development near floodplains (i.e. within 100 feet) will require a hydrology study to determine appropriate setbacks greater than 25 feet. **Page 111**

Response: A hydrologic analysis will be provided at the time of plat to ensure protection of the wash areas and to determine appropriate setbacks.

6. PUBLIC SERVICES/COST OF DEVELOPMENT:

A. Require developers to construct and pay for drainage facilities when their need precedes or exceeds the need of the city. **Page 122**

Response: The developer will construct the necessary drainage facilities in phases as appropriate as the project is constructed.

B. Ensure that major drainage channels are designed to convey the 100-year storm, that local streets can accommodate a 10-year storm, that collector streets can carry 10-year storm flows between curbs, and carry 50-year storm flows between property lines. Ensure that arterials and major arterials are designed to carry 10-year storm flows with one dry land in each direction, and that retention/detention basins on all new developments can store water from a 100-year 2-hour storm event. **Page 122, #'s 7 thru 11**

Response: All drainage and retention facilities will be constructed in accordance with City requirements.

C. Require private developers to install all public utilities & facilities to state and municipal standards, as required. **Page 123**

Response: Public utilities and facilities will be installed by the developer and/or service provider in accordance with applicable standards.

D. When evaluating the development proposal, all indirect costs shall be considered (e.g. recreation programs, public safety). **Page 124**

Response: Noted.

E. All developers requesting project approval must work with the local school district to determine impact on the school system and strategies to address impact. **Page 125**

Response: The developer is working with the school system to ensure its needs are addressed as they relate to demand generated by the proposed PAD.

F. Channel growth in areas that have existing infrastructure. **Page 125**

Response: This project is in an active growth area and infrastructure will be provided as required. Sunhaven is a fully zoned and entitled development approved in Maricopa County, and is within an area the City of Surprise has indicated for annexation. The Sunhaven PAD provides the opportunity for the City to annex the property and provide City services in this growing area.

7. ENVIRONMENTAL PLANNING/WATER RESOURCES:

A. Require development to provide the equivalent of 3,000 gallons per minute of well capacity and a 1,000,000-gallon water supply facility for every square mile of land developed. **Page 143**

Response: The project will adhere to well capacity and water storage requirements as defined within an approved Conceptual Water Master Plan for the project.

B. Utilize tank farm water supply facilities wherever possible. They will have multiple storage tanks and service large pressure zone defined areas. **Page 143**

Response: The project will meet the City's water supply and pressure requirements.

C. Require sixteen-inch and larger "plant-to-plant" water lines that connect the common water supply facilities. **Page 143, #'s 11 & 12**

Response: The project will adhere to water line and looping requirements as defined within an approved Conceptual Water Master Plan for the project.

D. Ensure that all roadways are paved and maintained to reduce particulates in the air. **Page 143**

Response: All roadways will be paved in accordance with City standards.

E. Avoid development in flood prone areas and limit grading practices that contribute to flooding and erosion. **Page 144**

Response: Engineering design will contemplate grading practices and drainage facilities intended to prevent flooding.

F. Encourage water conservation in all new development through the utilization of drought tolerant plant materials, efficient irrigation system (drip/low flow), and through water conserving fixtures in all new residential and commercial construction. **Page 144**

Response: Drought tolerant plant materials will be used. Appropriate water conservation fixtures will be provided to residents.

G. Ensure noise mitigation along all high-volume roadways (e.g., SR 303, Grand Avenue, Sun Valley Parkway). **Page 146**

Response: There are no single family residential development parcels proposed immediately adjacent to Grand Avenue. Appropriate noise mitigation measures will be provided as necessary in the 65 Ldn Luke Aux I Noise Contour area.

D. REGULATORY DEVELOPMENT STANDARDS

1. Purpose and Intent

This section sets forth the regulatory zoning provisions that are proposed to implement the community "vision". In accordance with Section 17.28.140 of the Surprise Zoning Ordinance, Planned Area Developments are designed to allow flexibility and innovation related to zoning district standards and guidelines in order to promote quality master planned communities without being bound to a "one-size-fits-all" approach to development. The Sunhaven PAD utilizes this flexibility provision by proposing modifications to the existing development standards, while at the same time ensuring that the spirit and intent of the standards are met. As an example, the purpose of limiting lot sizes to 58' wide minimum is primarily related to concerns regarding garagescape. This PAD includes design guidelines to ensure that even with smaller lot sizes, the undesirable elements such as garagescape typically created by smaller lot, cookie-cutter design is not allowed in Sunhaven.

The development regulations will govern the land use densities, intensities, and location criteria in the Sunhaven PAD. This section includes development standards related to property use, building and landscape setbacks, building heights, lot coverage requirements and single family residential design guidelines that will apply to the various land use categories. The intent of these standards is to establish clear minimum standards, allow for the orderly progression of development, and provide flexibility over time without compromising the overall vision for the Sunhaven PAD. Unless otherwise specified herein, all development within the Sunhaven PAD shall conform to all Ordinances, Codes, Policies and Regulations of the City of Surprise.

2. Zoning Base District

The entire Sunhaven PAD falls under the "Planned Area Development" (PAD) Zoning District in accordance with Section 17.28.140 of the Surprise Zoning Ordinance. Within this section of the PAD document, development standards and zoning regulations will be defined based on the land use categories as identified on **Figure 7**, *Land Use Master Plan.*

The development regulations that will guide the development of the Sunhaven PAD fall into three general land use categories, Residential, Commercial and Employment. Each of these land use categories will establish a unique set of development standards and/or design guidelines that will govern the regulatory development process during the multi-year implementation of the PAD. The sub-sections that follow will define the regulatory standards for each of the three general land use categories identified above.

a. Residential Land Use Categories

There are three distinct residential land use categories within the Sunhaven PAD. The three categories include Low Density Residential (LDR), Medium Density Residential (MDR), and High Density Residential (HDR). Each residential land use category has its own distinct set of development regulations as defined below.

1. LDR Land Use Category

The LDR land use category is designed to allow a broad mix of low density residential development within the 5 dwelling units per acre maximum density limit. Various lot sizes are proposed within the LDR land use category in order to attract a broad spectrum of housing choices and residential lifestyles within the Sunhaven community. All development within the LDR land use category will comply with the Single Family Design Review Guidelines as modified and/or defined within this section of the PAD.

Table 2, *Density Table* identifies each of the development parcels designated within the LDR land use category. Within **Table 2**, information is provided that identifies the parcel gross and net acreage, maximum land use density, target number of units, and projected lot size for each LDR development parcel. This table defines the general distribution of residential units throughout the PAD District. The representative distribution is particularly relevant to the evaluation of the planned infrastructure facilities (roadways, water lines, sewer lines, electrical distribution lines, etc.).

As discussed in the Master Plan section of this PAD, the target number of units is an estimated projection of the average number of units within each development parcel in order to project a maximum number of units for the project as a whole. The project will not exceed 8,001 total dwelling units overall. However, within each LDR development parcel, the actual unit count may vary on a parcel by parcel basis within the maximum designated density of 5 dwelling units per acre. No development parcel within the LDR land use category can exceed a gross density of five dwelling units per acre.

Additionally, **Table 2** indicates the various lot size (width and depth) and estimated number of units for each LDR development parcel. The various lot sizes, total projected units by lot size, and percentage overall of each lot size is provided in **Table 4** below. Since this project includes 2,116 acres, over 4,500 LDR units, and 35 LDR development parcels, flexibility over time is critical to ensure the success of the project. As such, the projected lot size within each development parcel may change to any lot size defined within the LDR land use category, so long as the overall percentage of lot size mix does not change by a variance of more than 3%. This will provide flexibility for the occasional shifting of lot sizes from parcel to parcel without any significant change to the overall percentage lot size mix. The only exception to this is that if smaller lots are replaced

with larger lots, no restriction is tied to percentage change in overall lot mix as the percentage of larger lots will drive down the percentage of smaller lots.

LDR Principally Permitted Uses

The LDR land use category shall conform to the principally permitted uses provided within the R1-8 zoning district of Section 17.24.020A of the Surprise Zoning Ordinance, with the following exceptions:

- Temporary Model Homes (up to 4 years) shall be permitted as a principally permitted use;
- Water production, treatment, storage, pump stations or related facilities, sewer lift stations, treatment and other related facilities, and other public infrastructure facilities shall be permitted as a principally permitted use;
- Manufactured housing and/or modular housing subdivisions shall not be permitted.

LDR Conditionally Permitted Uses

The LDR land use category shall conform to the conditionally permitted uses provided within the R1-8 zoning district of Section 17.24.020B of the Surprise Zoning Ordinance, except as provided for under LDR Principally Permitted Uses above.

LDR Permitted Accessory Uses

The LDR land use category shall conform to the permitted accessory uses provided within the R1-8 zoning district of Section 17.24.020C of the Surprise Zoning Ordinance.

LDR Development Standards

Table 4, LDR *Development Standards* provides the development standards for all development within the LDR land use category as defined within the PAD. The proposed development standards are established based on proposed lot sizes, and have been created to provide a level of design and development flexibility to allow for diverse and varied product types and to allow for changing market conditions, while ensuring a high quality of design for all lot sizes through design guidelines that will apply to the overall PAD. The standards identified within **Table 4** supercede the development standards provided within the R1-8 zoning district of Section 17.28 of the Surprise Zoning Ordinance as authorized within Section 17.28.140 of the Surprise Zoning Ordinance.

If there are any conflicts or inconsistencies between the LDR development standards defined within this PAD and the R1-8 zoning district development standards defined within the Surprise Zoning Ordinance, the PAD standards shall apply. Development within the LDR land use category shall defer to the R1-8 zoning district standards for any development or performance standards not defined with this PAD.

Table 4
LDR Development Standards

Lot Size	50' x 115'	53' x 115'	58' x 120	63' x 125	68' x 125	75' x 130'	80' x 130'
Estimated # Units	233	1,495	296	1,242	293	797	109
% Distribution (1)	5%	33%	7%	28%	7%	18%	2%
Minimum Area	5,700	6,050	6,900	7,700	8,400	9,650	10,325
Minimum Width	50	53	58	63	68	75	80
Minimum Depth	115	115	120	125	125	130	130
Maximum House Width	40	40	45	50	55	60	65
Building Setbacks (2) (3) (5) (9)							
Front (4)	18' BOS to garage; 16.5' ROW to garage; 12' for living area or side entry garage	18' BOS to garage; 16.5' ROW to garage; 12' for living area or side entry garage	18' BOS to garage; 16.5' ROW to garage; 12' for living area or side entry garage	18' BOS to garage; 16.5' ROW to garage; 12' for living area or side entry garage	18' BOS to garage; 16.5' ROW to garage; 12' for living area or side entry garage	18' BOS to garage; 16.5' ROW to garage; 12' for living area or side entry garage	18' BOS to garage; 16.5' ROW to garage; 12' for living area or side entry garage
Side	5' / 5'	5' / 8'	5' / 8'	5' / 8'	5' / 8'	5' / 10'	5' / 10'
Street Side	10'	10'	10'	10'	10'	10'	10'
Rear	15'	15'	15'	15'	20'	20'	20'
Rear Adjacent to Arterial	20'	20'	20'	20'	25'	25'	25'
Minimum Distance between Houses	10'	10'	10'	10'	10'	10'	10'
Maximum Building Height	30'	30'	30'	30'	30'	30'	30'

Notes:

(1)As the estimated number of units per lot size is a target and not an actual number of units, the actual number of units per lot size for the project as a whole may fluctuate as defined within Section D.2 of this PAD, so long as the percentage distribution within each lot size does not change substantially. However, if smaller lots are replaced by larger lots, there is no restriction on the percentage change to lot sizes.

(2) Fireplaces, pop-outs, bay windows, eaves, overhangs, patio covers and/or other appendages may encroach 2.5 feet into the front and side setbacks and 10' into the rear setbacks, so long as they do not encroach closer to 3 feet from a side yard or closer than 10 feet from a rear yard.

(3) Building setback shall apply equally to one and two story units

(4) BOS = back of sidewalk; ROW = right-of-way

(5) If a landscape tract of at least 10' minimum and 15' average is provided on an arterial street adjacent to a rear yard, or an 8' landscape tract is provided adjacent to a side yard, then the standard side and rear setbacks apply. For side yards, the wider of the two side yards (where applicable) shall be located on the street side.

(6) Pursuant to City application of single family residential design guidelines, lot coverage is not specifically regulated except than maximum lot coverage for this PAD is established by the building envelope created by the application of the required setbacks and allowable projections as defined in Note 2 of Table 4.

(7) Perimeter walls shall not exceed a height of 6'-8" measured from the outside edge of the wall with the exception of decorative columns which shall not exceed 7'-6". If combined with a retaining wall, a total height of 10'-8" is allowed (11'-6" for columns), with a maximum height of 4'-0" for the retaining portion of the wall.

(8) All non-residential development within the LDR land use category (such as churches, recreation center, etc.) shall comply with the development standards in Table 6 with the exception of building height, which shall comply with the residential district building height of 30'.

(9) A maximum of 1/3 of the lots within any subdivision may be less than the minimum standards by as much as 10%.

2. MDR Land Use Category

The MDR land use category is designed to allow a broad mix of medium density residential development within the 8 dwelling units per acre maximum density. The MDR land use category is designed to allow a variety of product types and design flexibility for medium density residential developments, including such innovative design options as auto-court cluster, green-court cluster, z-lot and zero-lot line configuration, detached or attached single family, condominium/town home design, etc. Due to the uniqueness and variety of the different types of medium density residential products allowed within the MDR land use category, a unique set of development standards are proposed and are set forth in **Tables 5a and 5b**: *MDR Development Standards.*

Table 2, *Density Table* identifies each of the development parcels designated within the MDR land use category. **Table 2** provides information regarding the parcel gross and net acreage, maximum land use density, and target number of units for each MDR development parcel. The data provided in this table and associated Land Use Master Plan (**Figure 7**) is designed to define the general distribution of MDR development units throughout the PAD District.

MDR Principally Permitted Uses

The MDR land use category shall conform to the principally permitted uses provided within the R-2 zoning district of Section 17.24.020A of the Surprise Zoning Ordinance, with the following exceptions:

- Single-family dwelling units, Z-Lots, zero lot line lots, and two-family structures shall be permitted as a principally permitted use;
- Cluster developments, such as auto-court, green-court, townhouse or other similar medium density residential product types shall be allowed at up to eight (8) units per cluster;

MDR Conditionally Permitted Uses

The MDR land use category shall conform to the conditionally permitted uses provided within the R-2 zoning district of Section 17.24.020B of the Surprise Zoning Ordinance.

MDR Permitted Accessory Uses

The MDR land use category shall conform to the permitted accessory uses provided within the R-2 zoning district of Section 17.24.020C of the Surprise Zoning Ordinance.

MDR Development Standards

Tables 5a and 5b, *MDR Development Standards* provide the development standards for all parcels within the MDR land use category as defined within the PAD. The development standards are provided to address various different product types in order to provide design and development flexibility while ensuring a high quality of design. In addition to the development standards, all MDR development parcels will be designed with the guidance of specific design guidelines to ensure all builders meet quality design standards. (See **Section D.4** for MDR Design Guidelines). These guidelines are similar to the City of Surprise Single Family Residential Design Guidelines, but are developed to respond specifically to the proposed product types to be developed within the MDR development parcels of this PAD.

If there are any conflicts or inconsistencies between the MDR development standards defined within this PAD and the R-2 zoning district development standards defined within the Surprise Zoning Ordinance, the PAD standards shall apply. Development within the MDR land use category shall defer to the R-2 zoning district standards for any development or performance standards not defined in this PAD.

Table 5a
MDR Development Standards

Site Setbacks (perimeter of district only)	
Front	20'
Side	10'
Street Side	10'
Rear	10'
Rear Adjacent to Arterial	20'
Perimeter Street Landscape Setback (Arterial)	15'
Perimeter Street Landscape Setback (Collector)	10'
Building Height	35'
Minimum Outdoor Living Area (on lot or common area)	300 sf/du average

Table 5b
MDR Development Standards

Use	Site Average Area per Dwelling Unit	Minimum Lot Width per Unit (6)	Front to Garage	Front to Living Area (4)	Interior Side (1) (4)	Aggregate Side (1) (4)	Corner Side (4)	Rear (4)
Two-Family Dwelling Structures	3,000	35'	18'	12'	5'	10'	10'	10'
Three Family Dwelling Structures	3,000	30'	18'	12'	5'	10'	10'	10'
Four Family Dwelling Structures	3,000	25'	18'	12'	5'	10'	10'	10'
Zero Lot / Z-Lot (5)	4,000	40'	18'	12'	0'	5'	10'	10'
Townhouse Cluster (2) (3)	3,000	25'	18' / 3'	3'	5'	10'	10'	10'
Auto/Green Court Cluster (2) (3)	3,000	25'	18' / 3'	3'	0'	5'	10'	10'
Accessory Structures	n/a	n/a	18'	-	3'	n/a	10'	10'
Structures for all other principal or accessory uses	n/a	n/a	18'	-	10'	n/a	10'	10'

(1) Attached buildings require no setback between dwellings.

(2) 3' front setback to garage is allowed for alley loaded or auto court loaded garages if a two car garage is provided for the unit and common visitor parking is provided within the subdivision or site plan at a rate of one visitor parking space per dwelling unit.

(3) Townhouse Cluster and Auto/Green Court Cluster may include up to 8 units per cluster.

(4) Fireplaces, pop-outs, bay windows, eaves, overhangs, patio covers and/or other appendages may encroach 2.5' into the front, side or rear setbacks, so long as they do not encroach closer to 3' from any required yard.

(5) Where a side yard is provided for zero lot line product, it shall be a minimum of 5'.

(6) No minimum site depth is required

(7) Lot coverage is established by the building envelopes created by the required setbacks and allowable projections as defined in this Table.

(8) If a landscape tract of at least 10' minimum and 15' average is provided on an arterial street adjacent to a rear yard, or an 8' landscape tract is provided adjacent to a side yard, then the standard rear and/or side setbacks apply. For side yards, the wider of the two side yards (where applicable) shall be located on the street side.

(9) Building setbacks apply equally to one story and two story units.

(10) Perimeter walls shall not exceed a height of 6'-8" measured from the outside edge of the wall. If combined with a retaining wall, a total height of 10'-8" is allowed, with a maximum height of 4'-0" for the retaining portion of the wall.

3. HDR Land Use Category

The HDR land use category is designed to allow multi-family residential development with a maximum density of 21 units per acre. The HDR land use category is designed to offer a variety of multi-family residential product types, such as multi-family apartments, attached condominium and town homes, and attached cluster product.

Table 2, *Density Table* identifies each of the development parcels designated within the HDR land use category. **Table 2** provides information regarding the parcel gross and net acreage, maximum land use density, and target number of units for each HDR development parcel. The data provided in this table and associated Land Use Master Plan (**Figure 7**) is designed to define the general distribution of HDR development units throughout the PAD District.

HDR Principally Permitted Uses

The HDR land use category shall conform to the principally permitted uses provided within the R-3 zoning district of Section 17.24.020A of the Surprise Zoning Ordinance with the following exception:

- All permitted uses allowed within the MDR land use category as defined within Section D.2.a.2 of this PAD shall be permitted as principally permitted uses within the HDR land use category.

HDR Conditionally Permitted Uses

The HDR land use category shall conform to the conditionally permitted uses provided within the R-3 zoning district of Section 17.24.020B of the Surprise Zoning Ordinance.

HDR Permitted Accessory Uses

The HDR land use category shall conform to the permitted accessory uses provided within the R-3 zoning district of Section 17.24.020C of the Surprise Zoning Ordinance.

HDR Development Standards

Development Standards for the HDR land use category shall comply with the development standards as defined within the R-3 zoning District of Section 17-28-060 of the Surprise Zoning Ordinance with the following exception:

- All development utilizing the permitted uses within the MDR land use category as allowed within the HDR Principally Permitted Uses section above shall conform to the development standards as defined within the MDR land use designation within Section D.2.a.2 of this PAD.

b. Commercial District

Approximately 193 acres of commercial land use is proposed to serve the projected population as well as surrounding area. The various commercial parcels have been located along the major arterial roads within the community to heighten retail exposure, promote visibility and access to the public and minimize traffic impacts within the neighborhoods.

The large commercial areas at the intersection of Tillman Boulevard and Lone Mountain Road are intended to be major community-wide commercial centers located at the intersection of two major arterial roadways. These development parcels are intended to provide large scale community-based retail and commercial services that will service both residents of the Sunhaven community as well as surrounding developments within the region. These parcels may include uses such as home improvement and gardening centers, movie theaters, major "big box" retail users, restaurants, and other community-wide retail and commercial services. The remaining commercial development parcels are smaller in scale and are intended to provide uses geared more toward neighborhood-scaled day-to-day services, including uses such as grocery, drug, dry cleaning, banking, dining, video rental establishments, etc. The specific design for the commercial properties, include components such as open space, plazas, landscaping, etc., will be determined at the time of development through the site plan review process as required by the development standards defined within this PAD and applicable City of Surprise commercial development standards.

Commercial Principally Permitted Uses

The Commercial land use category shall conform to the principally permitted uses provided within the C-2 zoning district of Section 17.24.030A of the Surprise Zoning Ordinance, with the following exceptions:

- Pawn shops are not allowed.
- Hardware stores with home garden centers are allowed as a permitted use provided the home garden center is completely enclosed within a building, gate or fence to a height of at least six feet.

Commercial Conditionally Permitted Uses

The Commercial land use category shall conform to the conditionally permitted uses provided within the C-2 zoning district of Section 17.28.080C of the Surprise Zoning Ordinance, with the following exceptions.

- Recreational vehicle, mobile home and manufactured home parks and overnight campgrounds are not allowed as a Conditionally Permitted Use.

Commercial Permitted Accessory Uses

The Commercial land use category shall conform to the permitted accessory uses provided within the C-2 zoning district of Section 17.28.080D of the Surprise Zoning Ordinance.

Commercial Development Standards

The standards in **Table 6**, *Commercial Development Standards*, shall apply to the Commercial land use category. Additional building and performance standards not defined within the Commercial Development Standards included within this section of the PAD shall conform to Section 17.28.080 and Section 17.32 of Surprise Zoning Ordinance as applicable.

If there are any conflicts or inconsistencies between the Commercial development standards defined within this PAD and the C-2 zoning district development standards defined within the Surprise Zoning Ordinance, the PAD standards shall apply. Development within the Commercial land use category shall defer to the C-2 zoning district standards for any development or performance standards not defined within this PAD.

Table 6
Commercial Development Standards

Minimum Lot Area	None
Minimum Lot Width	None
Distance Between Buildings	Per Building Code
Maximum Lot Coverage	None
Building Distance from Residential Zone	30 feet
Minimum Building Setback from any Street	20 feet
Minimum Side Yard Setback (perimeter of district only)	15 feet adjacent to non-residential use; 30 feet adjacent to residential use
Minimum Rear Yard Setback (perimeter of district only)	15 feet adjacent to non-residential use; 30 feet adjacent to residential use
Maximum Building Height	35 feet (3)
Minimum Street Landscape Area	20 feet average depth, 15 feet minimum
Minimum Perimeter Landscape Area (perimeter of district only)	15 feet average depth, 10 feet minimum

(1) all non-residential land uses within the residential zoning districts (such as churches, recreation centers, etc.) shall comply with the development standards defined within Table 6 above, with the exception of building height, which shall comply with the requirements within the residential zoning district in which it is located as defined in Table 4.

(2) Wall height for commercial development is as follows: 8'-0" maximum height for privacy/screen walls; 4'-0" maximum height for retaining walls; 12'-0"total maximum combined retaining wall/screen wall height.

(3) Building height subject to provisions in Section 17.28.080.F.2 of the Surprise Zoning Ordinance.

(4) All loading bays and trash receptacles shall be fully screened from the public street and adjacent residential land use (if applicable)

c. Employment District

Approximately 182 acres of employment land use is proposed within the Sunhaven PAD to serve the projected population as well as surrounding region. The employment parcels are located at the western edge of the site to comply with the Surprise General Plan, and to minimize impacts to the proposed residential land uses while providing close proximity to the residential districts to create opportunities for residents to live near where they work. The employment land uses are also located

immediately adjacent to the BNSF Railroad. This will provide opportunities for rail spur access to the employment parcels if acceptable to the Railroad and desired by the end user.

The intent of the employment development parcels is to allow uses such as educational institutions, warehousing, wholesaling, assembling, manufacturing, compounding, processing, packaging and treatment of materials that do not cause objectionable effects that would impose hazard to adjacent properties by reason of smoke, soot, dust, radiation, odor, significant noise or vibration, heat, glare, toxic fumes, or other conditions that would adversely affect the public health, safety and general welfare.

Employment Principally Permitted Uses
The Employment land use category shall conform to the principally permitted uses provided within the I-1 zoning district of Section 17.24.030A of the Surprise Zoning Ordinance, with the following exceptions:

- All Principally Permitted Uses within the Business Park (BP) zoning district are allowed;
- Churches are allowed as a Principally Permitted Use.
- Schools and institutions of higher learning, such as Colleges, Universities and Trade Schools are allowed as Principally Permitted Uses.

Employment Conditionally Permitted Uses
The Employment land use category shall conform to the conditionally permitted uses provided within the I-1 zoning district of Section 17.28.100C of the Surprise Zoning Ordinance.

Employment Permitted Accessory Uses
The Employment land use category shall conform to the permitted accessory uses provided within the I-1 zoning district of Section 17.28.100D of the Surprise Zoning Ordinance.

Employment Development Standards
The development and performance standards for the employment development parcels shall conform to the standards as defined within the I-1 zoning district, Section 17.28.100 and Section 17.32 of Surprise Zoning Ordinance.

3. Other Development Regulations

a. Walls
Privacy walls within residential areas shall be a maximum of 6'-8" in height measured from finished grade from the outside of the wall, with the exception of decorative columns which can be up to 7'-6" in total height. If a retaining wall is required, the retaining portion of the wall shall not exceed 4'-0". The combined total retaining wall and privacy

wall shall not exceed 10'-8" in total height (11'-6" for decorative columns).

4. Design Guidelines and Development Standards

As a large master planned community, the development of Sunhaven will provide many of the features that comprise points for compliance with the City of Surprise Single Family Residential Design Guidelines. The PAD Master Plan has been designed as a single planned community, with various features, amenities and guidelines that will apply to the entire development, not individual development parcels. For example, parks will be designed to be shared among various subdivisions, with multiple trail connections that meander through the entire community. Improvements such as these are designed and intended for the use and enjoyment of the entire community as opposed to an individual subdivision. With that understanding, the applicability of points for compliance as defined within this PAD will be attributed to the entire Master Plan as opposed to individual subdivision plats or development parcels. Additionally, various design guidelines have been developed to ensure a high quality built environment for all residential developments within the Sunhaven community. These will be implemented on a community-wide basis, as opposed to an individual subdivision basis. As such, the design guidelines identified below are intended to be demonstrated at the Master Plan level as part of the PAD. The only exception to this is the single family residential product design, which will demonstrate compliance with Design List C at the time of subdivision plat for the individual development parcels. The sections that follow demonstrate how the Sunhaven PAD will apply the Single Family Residential Design Guidelines at the master plan level.

a. Lot Size, Unit Count and Percentage Mix

The various lot sizes, the projected unit count, and the percentage of each lot size are identified in **Table 7** below. From the information contained in **Table 7**, the City of Surprise Single Family Residential Design Guidelines specifies a required point minimum from Design List B of 32 points, and a required point minimum from Design List D of 14 points.

Table 7
Estimated Lot Size/Category Mix

Projected Lot Size Mix		
Units	Lot Size	% Total
233	50	3%
1,511	53	19%
296	58	4%
1,256	63	16%
293	68	4%
807	75	10%
109	80	1%
710	MDR	9%
2,786	HDR	35%
8,001	Total	100.0%

b. Design List A

The Sunhaven PAD will comply with the requirements of Design List A for all LDR development parcels as modified below. Note that the items that have been modified from the existing language provided within the Single family Residential Design Guidelines Manual dated November 14, 2004 are items A, H, I, J and K.

A. The approximate percentage of each lot size width and/or land use category for the Sunhaven PAD is as set forth in **Table 7** above for all residential development parcels (note the LDR land use category includes all lots sizes from 50 – 80, but does not include the MDR or HDR categories.

B. Required Open Space: No less than 10 percent of the Gross Acreage of a Residential Development Project shall be open space, and not less than 5 percent of such Gross Acreage shall be open space which meets the requirements of Subsection 2 below. For purposes of meeting this requirement, open space shall include the following:
   1) A storm water retention area;
   2) A tract, other than a private street, which is owned and maintained by a homeowners association;
   3) A power line corridor if the corridor is improved and maintained by a homeowners association;
   4) A lake;
   5) A golf course;
   6) A site on which a public school will be constructed, if the site is actually conveyed, and not merely reserved, to the entity responsible for construction of the public school; and
   7) Any other similar area which, in the opinion of the City Council, provides a recreational, aesthetic, or other valuable benefit to the City of Surprise or to the Residential Development Project.

C. Project Entry: The Developer of a Residential Development Project shall construct features which provide a sense of neighborhood arrival, such as monument signage, decorative landscaping, specialty

pavement, enhanced wall detail, immediate accessibility to open space/trail system, etc., at all points at which a Residential Development Project may be entered from an arterial street.

D. Staggered Perimeter Wall: The Developer of a Residential Development Project shall construct a wall at the perimeter of the project abutting an arterial street which contains staggered or offset sections and/or other breaks to relieve the linear character of the perimeter wall abutting the arterial street.
E. Housing Product Variation: Refer to the SFR Home Product Design Guidelines.
F. Adjacent Elevations and Color Schemes: No house or structure shall have the same elevation or color scheme as those houses or structures located immediately to either side or directly across the street.
G. Adjacent Roof Lines: If two or more houses or structures abut an arterial street in the rear, the rear elevations of such houses or structures shall be geometrically varied and not more than two adjacent houses or structures shall have the same roof line.
H. Garage Configuration: Garages must contain an interior space which is not less than 19' in width measured from inside of wall to inside of opposite wall, and not less than 20' in depth measured from face of garage door to the back of the interior unobstructed space. This interior space shall be free of obstructions and intrusions, except that water heaters and related protective bollards may encroach into the interior space not more than 2'.
I. Off-street parking/driveways shall be defined in accordance with the requirements as defined with **Table 4** and **Table 5b** of this PAD.
J. All lot category requirements shall comply with the standards set forth throughout **Section D** of this PAD.
K. All setback requirements shall comply with the standards set forth throughout **Section D** of this PAD.

c. Design List B: Required Points = 32

The Sunhaven PAD will comply with the following design guidelines related to Design List B of the Single Family Residential Design Guidelines for all LDR development parcels.

- Design all corner lots so that the minimum width of each corner lot is at least 10 feet greater than the minimum lot width as defined within that subdivision, or on all corner lots, construct an 8' wide landscaped tract between the property line of the lot and the abutting street right-of-way. Convey such landscape tracts to a homeowners association and require the association to maintain the tracts and the adjacent rights-of-way to the same standard as other tracts and common areas maintained by the homeowners association (2 pts).
- Design and construct storm water retention areas which meander through the residential development parcels as greenbelts, as opposed to constructing a series of separate and distinct basins, and require a homeowners association to maintain the retention areas to the same standard as other tracts and common areas maintained by the homeowners association (4 pts).

- Design and construct landscape open spaces which are visible from both residential and arterial streets, and require a homeowners association to maintain the landscape open spaces to the same standards as other tracts and common areas maintained by the homeowners association. (2 pts)
- Along arterial streets, provide at least 600 feet of open space per mile, as measured along the linear boundary adjacent arterial street right-of-way. The open space will be maintained by the homeowners association. (3 pts)
- Design and construct all of the following:
  - Provide a minimum six feet of separation between the curb and the sidewalk on all arterial and collector streets, and install an 8-foot wide sidewalk; (2 pts)
  - Install in all arterial and collector streets a raised landscape median, and require a homeowners association to maintain the landscape medians to the same standard as other tracts and common areas maintained by the homeowners association; (2 pts).
  - Plant enhanced landscaping along the sidewalk adjacent to all arterial and collector streets, with a canopy tree planted every 50 feet on both sides of the sidewalk. The trees on opposite sides of the sidewalk must be offset to give the appearance that the trees are planted every 25 feet on center. Fifty percent of the trees must be 24-inch box trees or larger. Require a homeowners association to maintain the enhanced landscaping and trees to the same standard as other tracts and common areas maintained by the homeowners association (4 pts).
- Incorporate view corridors with open space areas throughout the development to take advantage of the mountain views and utilize view fences around houses abutting these view corridors so that open space and mountain views are visible from the houses; and require a homeowners association to maintain the open space areas to the same standard as other tracts and common areas maintained by the homeowners association. (4 pts)
- Establish pedestrian and bicycle access between residential and non-residential portions of the Project, or similar areas adjacent to the Project, including schools, libraries, shopping areas, etc., by incorporating fence and landscape penetrations into the pedestrian circulation element. Each penetration shall consist of a tract at least 30 feet wide and shall contain a trail to accommodate both pedestrian and bicycle traffic. Vehicular inhibitors such as bollards, maze gates, etc. must be installed at both ends of each tract, and the Developer must require a homeowners association to maintain the tracts to the same standard as other tracts and common areas maintained by the homeowners association. (6 pts)
- Design and construct paths and trails separate from roadways, which connect all open spaces areas and arterial roadways, and which enable bicyclists and pedestrians to travel throughout the development. (6 pts)

- Donate land to the City for municipal purposes such as fire stations, city parks, etc. (10 pts)
- On perimeter walls, provide berms, tree lines, hedgerows, and/or other similar means of breaking up the linear nature of the perimeter walls. Such features must be in addition to the open space areas along the perimeter and enhanced architectural features on the wall itself (6 pts, plus the ability to construct walls to height of 7 feet adjacent to arterial roadways).

The projected total number of points that may be achieved for the entire PAD within Design List B is 51 points. This number represents the total points that may be achieved on a Master Plan level. *The actual number of points will be at least the required minimum of 32 based upon a combination of the items identified above.*

d. Design List C: Required Points = 100

The Sunhaven PAD will comply with the Single Family Residential Home Product Design Guidelines published by the City of Surprise dated November 13, 2003 for all single family residential development within the LDR Land Use Category. Compliance with the Single Family Residential Home Product Design Guidelines will be established at the time residential building permits are requested for each subdivision. The Point List options as defined within the Single Family Residential Home Product Design Guidelines are provided as **Appendix I.**

e. Design List D: Required Points = 14

The Sunhaven PAD will comply with the following design guidelines related to Design List D of the Single Family Residential Design Guidelines for all LDR development parcels.

- Provide a trail system that connects all open space areas with the residential development parcels and created pedestrian linkages with surrounding residential and commercial developments. Along the trail system, construct rest areas at every quarter mile, consisting of a seating area which accommodates at least four persons and a shade area composed of an architectural shade structure, or mature landscaping such as a canopy of trees, or a combination of both. Require a homeowners association to maintain the trail system to the same standards as other common areas maintained by the homeowners association. (4 pts)
- Construct and convey to a homeowners association active outdoor recreational facilities for adults, such as full court basketball courts, tennis courts, volleyball courts, and other similar recreational facilities. Require the homeowners association to maintain these recreational facilities to the same standard as other common areas maintained by the homeowners association. (4 pts)
- Construct and convey to the homeowners association a large open space corridor, with a minimum width of 75 feet, and an average width of 100 feet, through the Residential Development Project. The

corridor must be planted with mature trees and other plants listed on the City's approved plant list, and must provide view corridors and a trail system. Lots that back up to the corridor on at least one side shall be bordered view fences which create view corridors. The view fence may be constructed either completely of wrought iron or of wrought iron and masonry, and must comply with the City's ordinance related to swimming pool fences. Restrict the use of the corridor to pedestrian and bicycle access by residents of the Project. Require a homeowners association to maintain the corridor to the same standards as other common areas maintained by the homeowners association. (12 pts)

- Provide common lakes and/or open space natural wetlands, using a source of water other than the City's water system, for active or passive use and enjoyment. The homeowners association will maintain the lakes/wetlands. (12 pts)
- Provide open space is excess of 10 percent gross acreage for residential development areas. The homeowners association will maintain the open space areas. (10 pts)

The projected total number of points that may be achieved for the entire PAD within Design List D is 42 points. This number represents the total points that may be achieved on a Master Plan level. *The actual number of points will be at least the required minimum of 14 based upon a combination of the items identified above.*

f. Additional Design Guidelines for MDR Parcels

Architectural Guidelines

In addition to the guidelines identified above, the MDR development parcels will provide architectural design guidelines to ensure a high quality product design. The additional design guidelines applied to the MDR parcels are provided below:

Non-Garage Dominant

- Auto Court Cluster – garages are internal to an auto court with main entrances along a landscaped paseo or courtyard.
- Green Court Product – garages are along an alley with the main entrances along a landscape paseo or courtyard. Garages do not directly face public streets;
- Z-Lot: provides for staggered lot lines allowing for product diversity, including staggered lot widths when viewed from the street, as well as rear-loaded and side-entry garages;
- Townhome or Condominium – garages are internal to the development and not directly facing public streets;

Building Form

- High quality "stylized" or "theme" architecture will be used to add character and quality to the community;

- Solar orientation and climatic design will be considered in the site design process;
- Visually interesting architecture, including variation in form, massing, heights, roof styles and site orientation will be considered;

Building Facades

- Building facades will reflect the design intent of the community theme and will provide an architectural face that relates to the neighborhood and community character;
- Architectural details related to color, type and application of material and building form will be coordinated for all elevations;
- The rear and sides of elevations visible from the public street or public open space areas will be architecturally comparable to the front elevation;
- A variety of architectural design features, techniques, patterns, materials, and colors will be used to create variety and visual interest in the facade;

Roof Architecture

- A variety of roof forms and styles will be used to create visual interest and diversity of roof styles;
- Chimneys, roof flashing, rain gutters, downspouts and other roof protrusions will be painted and finished to match the color of the adjacent surface;

Colors and Materials

- Materials applied to a building elevation will wrap around onto adjoining walls of a structure to visually appropriate termination points to provide design continuity and a finished appearance;
- Variation of colors in roof and facade treatment will be provided to maintain harmony and consistency with the overall character of the community;
- Colors will be compatible with the general environment of the community, and should help reduce reflected heat and glare into the surrounding area;
- Colors should be used to accent entry-ways and special architectural features;

Windows and Doors

- Windows and doors will be aligned and sized to bring order to the building façade;
- Windows and doors will be sufficiently recessed to create façade patterns that add variety and visual interest to the design theme of the building;

5. Amendment Procedures

The following provisions are intended to provide criteria for the determination of minor and major amendment procedures for the Sunhaven PAD.

Formal amendments to the PAD as represented in the narrative and/or graphics contained within the Sunhaven PAD may become necessary from time to time for various reasons to respond to changing market or financial conditions, to update the PAD to reflect new development conditions and/or to respond to the requirements of potential users or builders on the property. Amendments to the approved PAD may be requested by the Master Developer, other developers within Sunhaven, a property owner, or property owner's agent. Unless otherwise requested in the application, any proposed change will not affect development units not included in the proposed amendment request. Only the contents of the specific amendment request may be considered and acted upon by the appropriate City staff and/or the Planning Commission and City Council. The plan defines two types of amendments to the PAD, Minor Changes and Major Changes. Below is a description of the criteria and process required for the two types of changes:

Minor Changes

The City of Surprise Community Development Director and/or City Engineer may allow minor changes to the PAD, provided that such changes are not in conflict with the overall intent as expressed in the PAD document. The following items shall be considered as minor changes to the PAD:

- Changes in configuration of individual development parcels to include modifications to boundaries, division of larger parcels, or combinations of parcels by a maximum of 20%, as long as there is no net loss of open space and no net increase in the total number of units allowable within the PAD;
- Changes to the community infrastructure, such as drainage, water and sewer systems which do not have the effect of increasing or decreasing development capacity in the PAD, nor change the overall intent of the PAD;
- Changes or modifications in lot sizes and setbacks by up to 10% of the required development standard in order to accommodate for unique circumstances or specific site constraints, so long as the change does not conflict with the City of Surprise Building Code or off-street parking requirements as defined within the PAD;
- Any analogous interpretations of the list of permitted, conditional and secondary uses of the property as set forth in the PAD, as determined by the Community Development Director;
- Changes in residential densities or unit count by up to 10% of the maximum allowable in any development parcel, provided the increase does not cause an increase in the total allowable unit count within the PAD;

- Minor modifications or adjustments to roadway alignments and/or parcel configuration so long as the proposed modification does not change the overall intent of the PAD;
- Minor modifications to the location and size of trails and pedestrian paths, so long as the modification meets the general intent of the PAD;
- Relocation of a school or park site, which either enhances the opportunity to create a sense of neighborhood and community, to better centralize school and/or park sites based on actual development densities, or to implement the mutual desires of the school district or city parks department and the developer, so long as the overall size of the park or school site is not reduced by more than 10%, and the land uses and densities of the parcels proposed for the revision do not result in a net increase in total number of units.
- Other changes not identified above, but deemed appropriate by the Community Development Director, as long as the change does not impact the general health, safety, and welfare of the residents of the City of Surprise and does not impact the overall intent of the approved PAD.

Major Changes

A Major change is a change that does not qualify as a minor change as defined above, and that significantly alters the intent of the approved PAD. Major Changes shall comply with the requirement set forth in Section 17.36.060.G.2 of the Surprise Zoning Ordinance.

ORDINANCE #07-04

AN ORDINANCE OF THE MAYOR AND COUNCIL OF THE CITY OF SURPRISE, ARIZONA, APPROVING A PLANNED AREA DEVELOPMENT, PAD05-335, FOR A PROJECT KNOWN AS SUNHAVEN, CONSISTING OF REZONING APPROXIMATELY 2,116 ACRES FROM R1-10, R1-6, R-4, C-2, IND-1, RURAL 43 (COUNTY DESIGNATIONS) TO PLANNED AREA DEVELOPMENT (PAD). THE SUBJECT SITE IS GENERALLY BOUNDED BY DOVE VALLEY TO THE NORTH, 187TH AVENUE TO THE EAST, THE DIXILETA ROAD ALIGNMENT AND GRAND AVENUE TO THE SOUTH, AND 203RD ALIGNMENT TO THE WEST.

WHEREAS, this Ordinance has been properly noticed for public hearing and the necessary hearings and opportunity for public input have been completed; and

WHEREAS, rezoning of the subject property will not depreciate surrounding property values and, at the same time is in harmony with the purposes and intent of the zoning ordinance, the plan for the area, and the Surprise General Plan 2020.

NOW, THEREFORE, BE IT ORDAINED by the Mayor and Council of the City of Surprise that:

Section 1. This Ordinance is not of a general and permanent nature and shall not be codified.

Section 2. The property described in the staff report is rezoned from R1-10, R1-6, R-4, C-2, IND-1, Rural 43 (County designations) to Planned Area Development (PAD).

Section 3. The development plan for the property described in the PAD document entitled "Sunhaven", as application PAD05-335, a copy of which is on file in the Community Development Department, is approved.

Section 4. All present and future owners of the property shall develop the property only in accordance with the requirements and exhibits found in the PAD document, and in compliance with the Stipulations contained in Exhibit A.

Section 5. The applicant shall submit a preliminary plat for the property or a portion thereof within twelve (12) months from the date the ordinance is approved, and the applicant shall pull a permit for construction within the property within thirty-six (36)

months from the date the ordinance is approved. In the event either of the above do not occur within their respective time periods, the City Council shall take the appropriate action to revert the zoning being approved with this Ordinance.

Section 6. This Ordinance shall become effective thirty-one (31) days after formal passage by the Council.

PASSED AND ADOPTED this 22nd day of February, 2007.

~~Joan Shafer, Mayor~~ Gary "Doc" Sullivan
vice-Mayor

ATTEST:

Sherry A. Aguilar, City Clerk

APPROVED AS TO FORM:

Michael D. Bailey, City Attorney

Yeas: Vice-Mayor Sullivan, Council Members; Arismendez, Elkins, Foro & Johnson. (Abstained-Bails) (Absent-Shafer)

Nays:

STANDARD STIPULATIONS:

a) Major changes to this P.A.D. with regard to use and intensity as defined by the zoning ordinance, must be processed as a revised application with approval by the City Council upon recommendation of the Planning and Zoning Commission. Minor changes to this P.A.D. may be administratively approved by the City Manager and the Community Development Director;

b) All infrastructure shall be constructed pursuant to the provisions of 16.20 of the Surprise Municipal Code or an approved development agreement, whichever applies; and

c) The applicant shall include these stipulations (STANDARD and SPECIAL) and all necessary revisions to text and exhibits in the final P.A.D. document.

SPECIAL STIPULATIONS:

d) All items to which the P.A.D. document commits within the Design Guidelines compliance section of the zoning document shall be subject to further review and approval by the Community Development to ensure compliance with adopted PAD standards;

e) By its submittal of the P.A.D., the applicant - as landowner - agrees and approves to the open space designated in the approved P.A.D. plan recognizing that refinements will occur during the engineering process;

f) The lighting standard for the project shall be subject to further review and approval by the Community Development , and the applicant shall comply with any adopted lighting standards that exist prior to the first final plat approval;

g) All roadway and parking lot light fixtures to be full cut-off with no light spill onto adjacent properties.

h) Applicant shall be responsible for their contribution to the regional transportation impact fee as approved by the City Council.

i) As part of the plat process, applicant will work to provide subdivision access at the quarter-mile points along arterial and collector streets or as may be approved by the City.

j) The applicant and the Community Development Department will work together to continue to incorporate superior site design into the plat map process for phases 3,4 and 5 to ensure quality of community character and community impact in accordance with the Sunhaven Design Guidelines in Section D.4 of the PAD. The intent of the superior site design is to ensure neighborhood integration through vehicular and pedestrian linkages between different subdivisions and community focal points, such as parks, schools and commercial areas.

k) If the U.S. Postal Service requires communal postal boxes, applicant shall install adequate lighting over said postal receptacles.

l) Wall heights shall be consistent with the City of Surprise zoning ordinance, except as set forth in Section D.3 of the Sunhaven PAD regarding decorative wall caps, decorative columns and retaining walls.

m) Minor changes to the roadway cross sections can be made by the developer and/or the City as long as the pavement widths and ultimate right-of-way widths do not change. (The Vehicle and Bicycle Circulation Plan as shown in the PAD booklet has been amended).

n) Street/road connectivity shall be provided to adjoining developments. Street stub outs to be provided to undeveloped areas.

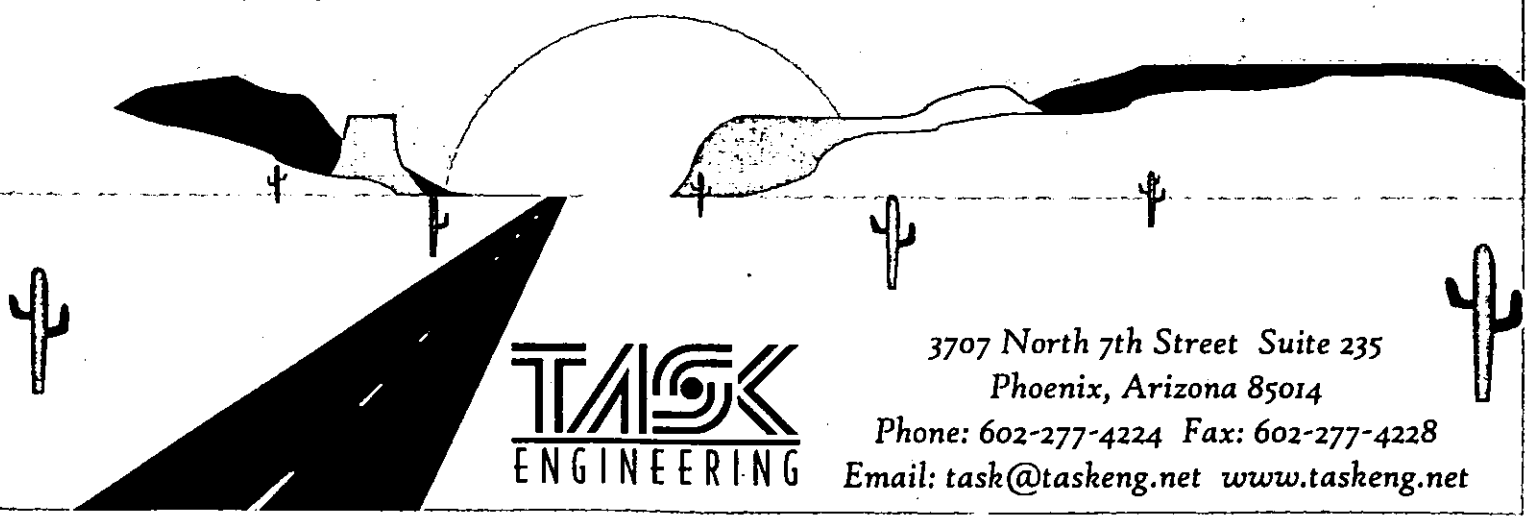
o) Reclaimed/effluent water shall be used for irrigation of parks, common area, tracts, and lakes in accordance with the Sunhaven Pre-Annexation Development Agreement.

Sunhaven
Traffic Impact Study

RECEIVED
DEC 21 2005
COMMUNITY DEVELOPMENT

Prepared for:
Sunhaven I, LLC

December 21, 2005



TASK ENGINEERING
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Sunhaven
Traffic Impact Study

Prepared for:

Sun Haven I, LLC
426 North 44th Street, Suite 240
Phoenix, Arizona 85008

By:

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December 21, 2005

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INTRODUCTION

This revised report addresses the anticipated traffic impacts of Sunhaven, a proposed mixed-use commercial/employment/residential development located in a portion of Maricopa County, Arizona and is planned to be annexed by the City of Surprise. The site is loosely bounded by Dove Valley Road to the north, 203rd Avenue to the west, 187th Avenue to the east, and Grand Avenue (US 60) which runs from southeast to northwest along the southern boundary. The site is comprised of 77 individual parcels and sits on approximately 2,120 acres. Figure 1 shows the vicinity and surrounding roadway network of the site.

Figure 2 is a general land use plan for the site. It contains housing lots with variable dwelling unit density, various parks and schools, and multiple commercial and employment parcels.

The purposes of this study are:

1. To determine the access and egress needs to serve the site,
2. To evaluate the traffic impact of the site on the area roadway network, and
3. To meet requirements of Maricopa County and the City of Surprise for a traffic impact study.

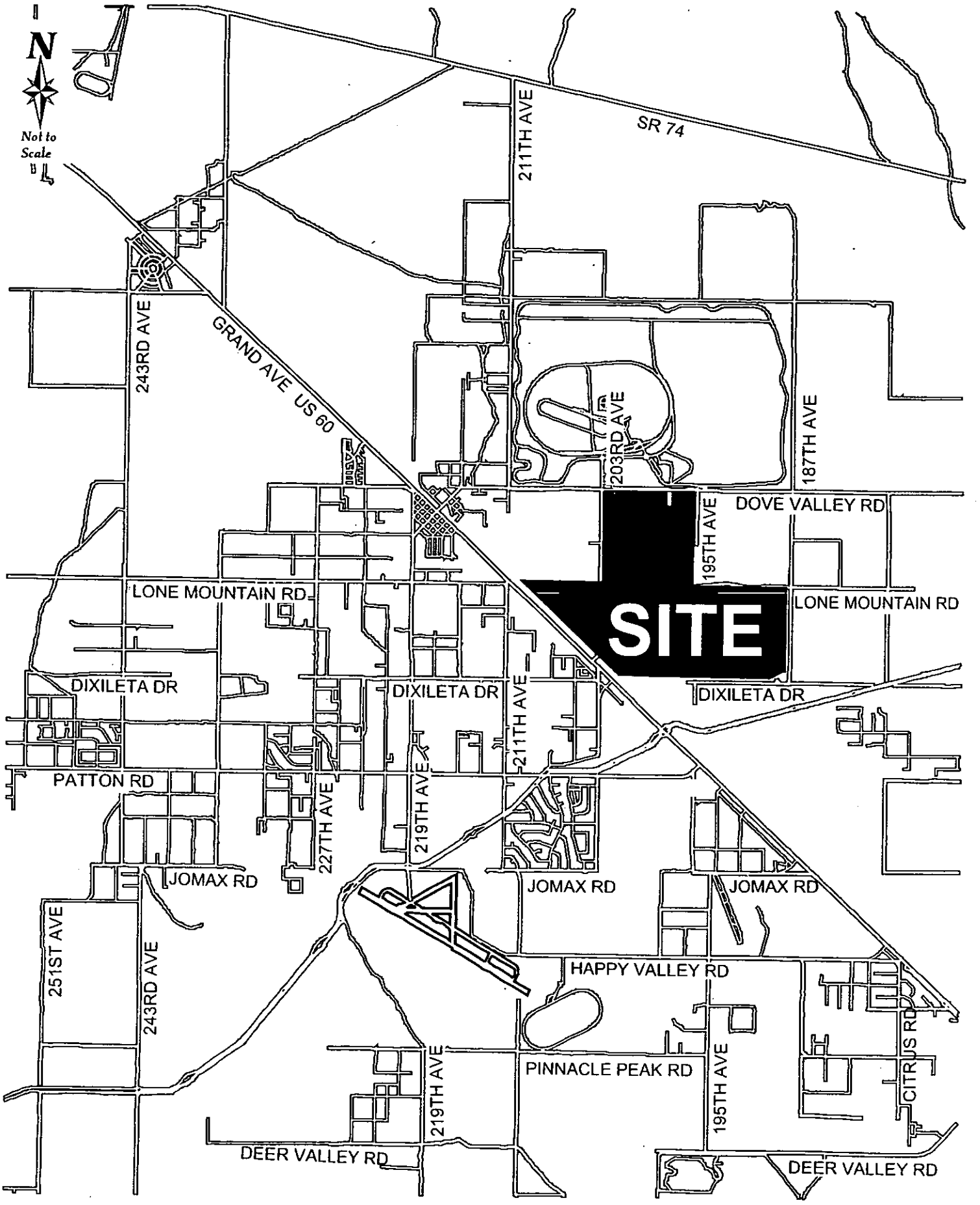
This study is classified as a Maricopa County Department of Transportation (MCDOT) Category IV development because it is expected to produce over 1,500 peak hour trips. Traffic conditions were analyzed for background traffic in Year 2016, the assumed "interim" year, and Year 2030 plus full development of the site, since this represents the critical design year. All intersections within the site, along the site border and within a reasonable distance from the site were analyzed.

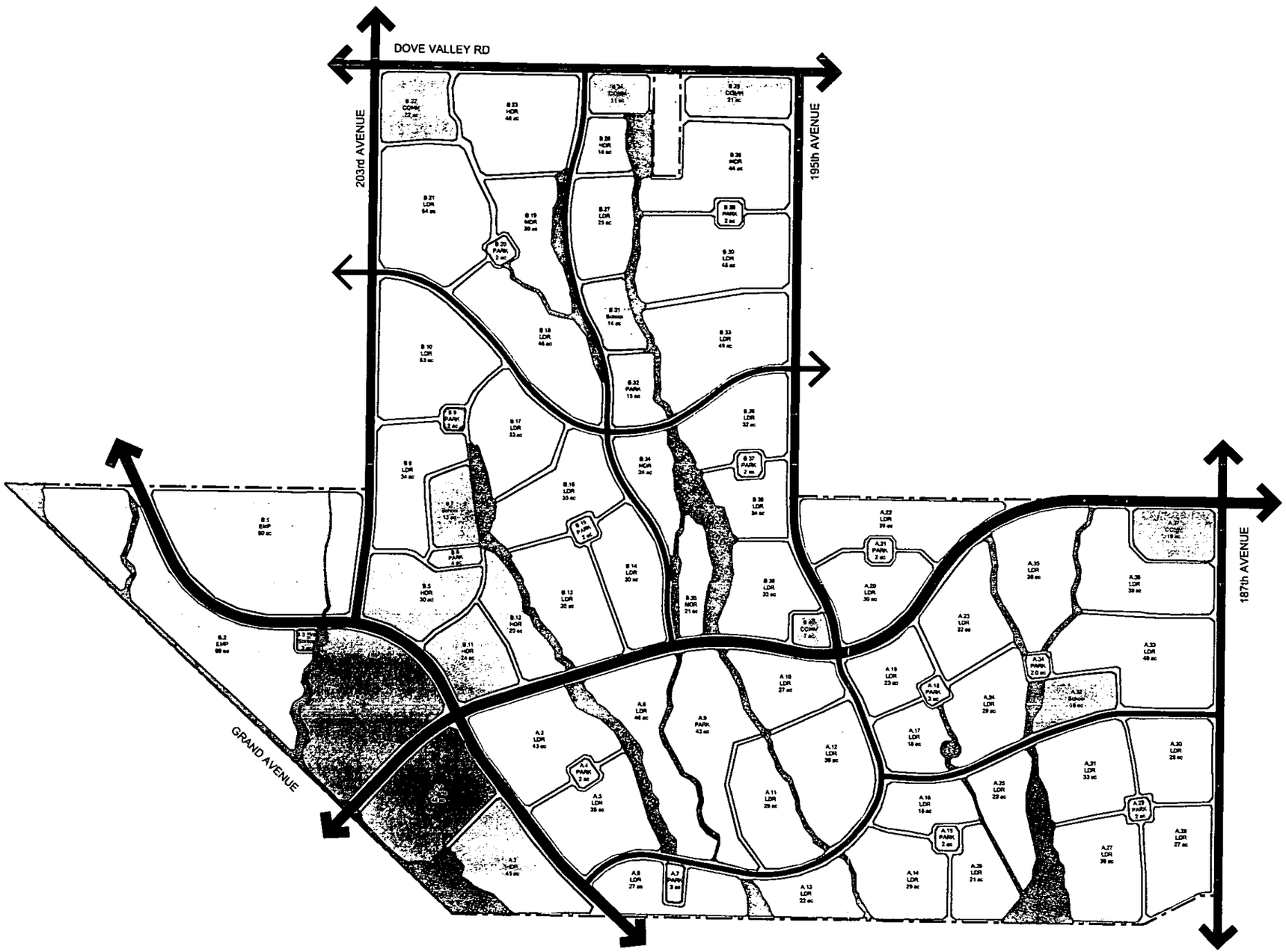
The revised report incorporates comments from the City of Surprise dated October 5, 2005. The comments and a response memorandum are found in Appendix F. This report also incorporates changes to the land use plan.

The conclusions of this report are listed in the final section, RECOMMENDATIONS. Appendix A contains summaries of individual capacity analyses. The following sections detail the methodology used to reach these conclusions.

DESCRIPTION OF PROPOSED DEVELOPMENT

The schematic site plan for the proposed development is shown on Figure 2. The proposed site is within Maricopa County but is planned to be annexed by the City of Surprise in early 2006. It is bounded by Dove Valley Road to the north, 203rd Avenue to the west, 187th Avenue to the east, and the US 60 along the southern border of the site.


N
Not to Scale
SR 74
211TH AVE
243RD AVE
GRAND AVE US 60
203RD AVE
187TH AVE
DOVE VALLEY RD
195TH AVE
SITE
LONE MOUNTAIN RD
LONE MOUNTAIN RD
DIXILETA DR
DIXILETA DR
DIXILETA DR
211TH AVE
PATTON RD
227TH AVE
219TH AVE
JOMAX RD
JOMAX RD
JOMAX RD
251ST AVE
243RD AVE
HAPPY VALLEY RD
PINNACLE PEAK RD
219TH AVE
195TH AVE
CITRUS RD
DEER VALLEY RD
DEER VALLEY RD



Sunhaven

City of Surprise, Arizona

Planned Area Developn

Figure 7
Land Use Master Plan

LEGEND

- Low Density Residential (5 du/ac)
- Medium Density Residential (8 du/ac)
- High Density Residential (21 du/ac)
- Commerical
- Park/Open Space
- Multi Use/ Employment
- Fire Station
- School
- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary

Parcel Label:
Phase Parcel Number
Land Use Designation
Gross Acreage

NORTH
Not To Scale

Date: 05-12-05
Drawn By: ES/MR
Revised: 11-22-05

DEI Professional Services LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8605

CVA Urban Design Studio L.L.C.
Master Planned Communities, Land Planning, Site Planning & Design, Environmental Analysis & Landscape Design
7502 East Main Street
Scottsdale, Arizona 85251
Phone (480)994-0994
Fax (480)994-7322
www.cvadesign.com

The 2,120-acre site is a mixed-use residential, employment, and commercial development consisting of the following:

- 1,314 acres with 4,505 dwelling units - low density residential
- 118 acres with 710 dwelling units - medium density residential
- 181 acres with 2,786 dwelling units - high density residential
- 88 acres - community and neighborhood parks
- 43 acres - three elementary schools
- 193 acres - mixed use commercial
- 180 acres - mixed use employment
- 3 acres – public use (fire station)

There is also ± 112 acres of natural open space, 19 acres of arterial street landscape tracts, and 49 acres of subdivision tracts and open space.

It is assumed for the purposes of analysis that Phases 1-5 will be completed by the "interim" condition, Year 2016. All six phases are planned to be completed by Year 2019. The existing site location is made up of vacant land. The Burlington Northern Santa Fe Railroad (BNSF) that runs parallel to US 60 on the southern border of the site. The only nearby existing development in the area consists of a few sporadic dwelling units and the Daimler-Chrysler proving grounds to the north of Dove Valley Road.

The proposed Asante North mixed use development to the south of the Sunhaven site. Other proposed development lies to the west of 203rd Avenue. The Daimler-Chrysler site has recently been sold with the expectation of future development of a major mixed-use community.

DESCRIPTION OF ROAD NETWORK

Figures 1 and 2 show the roadways serving the site and the roadways that will serve the site in the future.

Existing Road Network

Currently, the only roadway access that exists is 203rd Avenue, a two-lane roadway with a posted speed limit of 50 mph, and US 60, a four-lane median divided roadway with a posted speed limit of 65 mph. The at-grade crossing of 203rd Avenue is the only crossing of the BNSF tracks in this area.

The current alignment of 203rd Avenue is planned to change by the buildout of this project as can be seen on Figure 2. The existing at-grade crossing will be the future Lone Mountain Road grade crossing.

Planned Regional Road Network

The site plan, as shown on Figure 2, calls for one connection to US 60. This connection is planned to be the realigned Lone Mountain Road. It is planned to be an at-grade intersection. The site plan also calls for the proposed Tillman Boulevard road that will run parallel to the US 60. Tillman Boulevard serves Asante and Asante North to the southeast of Sunhaven, and other development planned to the northwest of Sunhaven.

There are also several other arterial and collector roads planned to serve the site. These will act as alternate distributors of the site traffic. The City of Surprise Transportation/Circulation Plan, adopted in November 2000, was used as the basis for planned roadway elements. A copy of this plan is included in Appendix E.

A breakdown of the specific planned roadway configurations follows:

- US 60 is planned to be a full six-lane Principal Arterial by Year 2030. An at-grade signalized intersection is planned at the realigned Lone Mountain Road/US 60 intersection.

- Tillman Boulevard is planned as a Major Arterial in the future. It will have a six-lane cross section and planned right of way of 136 feet. It will run parallel to US 60 and continues north until it connects with 211th Avenue, a north-south Minor Arterial.

- Dove Valley Road is planned as a Parkway that extends east and west and intersects the US 60 west of the site. It has a planned right of way of 200 feet (100 feet per half street) and an ultimate configuration of six through lanes.

- One Hundred Eighty Seventh Avenue south of Lone Mountain Road is planned as a Minor Arterial in the future. It is planned to have a four-lane cross section. The planned right of way is a 55-foot wide half street.

- On-hundred Eighty Seventh Avenue north of Lone Mountain Road is planned as a Parkway in the future. It is planned to have six through lanes and a 200-foot total right of way width (100 feet per half street).

- Lone Mountain Road as it enters the Sunhaven site will curve to the southwest and intersect the US 60. It is planned as a six-lane Major Arterial through the vicinity of the site. It is planned to have 136 feet right of way.

- Two Hundred Third Avenue is a section line road and should be built as a Minor Arterial on 110 feet of right of way. 203rd Avenue is planned to extend north of Dove Valley Road, but will terminate at Tillman Boulevard to the south.

- One Hundred Ninety Fifth Avenue is planned to be built as a Minor Arterial on a 55-foot half street right of way. It is not planned to extend north of Dove Valley Road. It turns into Collector B to the south.

- Collectors A, B, and C are all planned Residential Collector roads. They loop around the site and serve the site by distributing the site traffic to the arterial roads. The planned right of way is 80 feet. Collector A is not anticipated to extend beyond the site for Year 2016 conditions. Collector A will extend further to the east and west by Year 2030 when the surrounding has been built out.

- Collector D is planned as a "High Volume Collector" with four lanes and 105 feet of right of way.

The internal circulation of the site is shown on Figure 2.

TRIP GENERATION

Site traffic from the proposed development is the total estimated vehicle trips to and from the region on an average weekday after the area has been completely built out. This is called trip generation. Vehicle trips are estimated for a total average weekday and for AM and PM peak hours. *Trip Generation, Seventh Edition,* published by the Institute of Transportation Engineers (ITE) in 2003 was the source for the trip rates used in this study.

For a large area such as this, some trips will have both their origin and their destination end within the study area. These are referred to as "internal" trips. Other trips will have one end, either origin or destination, in the site and the other end outside the site. These are referred to as "external" trips. The arterial street approaches to the site that these external trips use is referred to as "external stations."

Each trip has two trip ends. The trip Production end represents the end of the trip where the decision to make a trip is made. Generally, this is the home end of a home-based trip. The attraction end of the trip is generally the end where the trip maker engages in some activity, such as employment, shopping, education or recreation. For this study, trip Productions and Attractions are also used to separate internal and external trips. The outside end of a trip from the site is generally considered the Attraction end. Trip Productions and trip Attractions are calculated separately in the trip generation table.

The following assumptions are used to determine trip productions and attractions within the study area:

1. Ninety five percent of all trip ends generated in residential parcels are defined as Productions. The other five percent are assumed Attractions.

2. Commercial and employment parcel Attractions vary based on the specific location of the parcel and the likelihood that trips will come from within the site. The following Attractions were assumed for the commercial and employment parcels:
   - Twenty five percent Attractions for parcels A37, B1, B2, B21 and B24
   - Thirty percent Attractions for parcels A1 and B23
   - Thirty five percent Attractions for parcel B4
   - Sixty five percent Attractions for parcel B39
3. One hundred percent of trips generated by the parks are assumed Attractions. These parcels serve the surrounding community almost exclusively.
4. Eighty-five percent of trips generated by the elementary schools are assumed Attractions. These parcels primarily serve the surrounding community but the other 15 percent Attractions represent staff and deliveries.
5. External stations are assumed 100 percent Attractions. External stations are the arterial streets on which travelers access the study area. Total external station Attractions are equal to the difference between total study area Productions and total study area Attractions. Therefore, each trip Production from the study area has an Attraction, either in another parcel of the study area, or outside the study area.

Since some trips have both an origin and destination within the Sunhaven traffic study region, the total number of trips entering and leaving the site is less than the total number of trip ends generated by the developments.

For Year 2016, Phase 1-5 buildout of the Sunhaven development will generate 113,918 daily trips with 7,264 morning peak hour trips and 11,269 evening peak hour trips. A summary of the trip generation is shown on Table 1, the detailed trip generation is found in Appendix B (Appendix B-1).

At full buildout, the Sunhaven development will generate 158,258 total trip ends per day, with 10,711 morning peak hour trips and 15,959 evening peak hour trips. A summary of the trip generation is shown on Table 2, the detailed trip generation is found in Appendix B (Appendix B-2).

The inbound and outbound splits of AM and PM trips are based on results of trip generation using ITE data as explained below.

The various columns in the trip generation tables in Table 1, Table 2, and Appendix B are explained below.

Parcel # defines groups of land uses on the site plan.

Parcel Type describes the parcel zoning. (i.e. LDR = Low Density Residential)

Units names the independent variable used to calculate trips. It varies according to the parcel. TGSF is the number of square feet in a commercial parcel divided by 1,000. This was converted from acres with the floor area ratio (FAR) applied. DU is number of dwelling units.

Amount is the amount of the units in the parcel.

LUC is the ITE Land Use Code. It refers to the section of the ITE manual from which the trip rates were obtained.

Trip Rate presents the number of daily, AM peak hour and PM peak hour vehicle trips to and from the subject land use per unit.

Table 1
Summary Trip Generation (Year 2016)
Sunhaven Traffic Impact Study

				Trips				
Parcel Type	**Units**	**Amount**	**LUC**	**Weekday**	**AM In**	**AM Out**	**PM In**	**PM Out**
Single Family	DUs	4,194	210	40,137	786	2,359	2,669	1,567
Apartment	DUs	2,785	220	18,715	284	1,136	1,122	604
Shopping Center	TGSF	1,091	820	46,858	686	438	1,964	2,128
Townhouse	DUs	711	230	4,166	53	260	248	122
Elementary School	Students	3,000	520	3,870	693	567	378	462
Park	Acres	75	412	171	1	0	2	3
		Total Trips		113,918	2,503	4,761	6,383	4,886

Table 2
Summary Trip Generation (Year 2030)
Sunhaven Traffic Impact Study

				Trips				
Parcel Type	**Units**	**Amount**	**LUC**	**Weekday**	**AM In**	**AM Out**	**PM In**	**PM Out**
Single Family	DUs	4,194	210	40,137	786	2,359	2,669	1,567
Apartment	DUs	2,785	220	18,715	284	1,136	1,122	604
Shopping Center	TGSF	1,691	820	72,630	1,063	679	3,045	3,298
Office Park	TGSF	1,626	750	18,568	2,518	311	341	2,097
Public Use (Fire Station)	Acres	2	---	0	0	0	0	0
Townhouse	DUs	711	230	4,166	53	260	248	122
Elementary School	Students	3,000	520	3,870	693	567	378	462
Park	Acres	75	412	171	1	0	2	3
		Total Trips		158,258	5,398	5,313	7,805	8,154

AM % In and PM % In are the percentages of AM and PM vehicle trips arriving inbound at the land use. The remaining percent of trips are leaving outbound. For instance, 61 percent of AM peak hour trips are arriving at a shopping center, and the remaining 39 percent are leaving the shopping center. For daily trips, it is assumed that 50 percent are inbound trips and 50 percent are outbound trips.

Trips are the calculated number of trips. They are calculated as the amount times the rate times percent inbound or outbound.

The ITE average trip rates were used for all parcels. Most rates are peak hour of adjacent street. Park rates used peak hour of the generator, because the peak hours of adjacent street rates were unrealistically low.

Several commercial and employment parcels have large 404 washes running through them. The 404 acreage was subtracted from the area for these washes to obtain gross acreage before reduction for right of way. A floor area ratio (FAR) of .25 was applied to the commercial gross average estimates and the employment estimates. From this, estimates of building area were obtained for trip generation. This is consistent with actual densities from similar sites, and is equivalent to assuming that net acreage is 75 percent of gross acreage and applying an FAR of 0.25 to net acreage.

Productions and Attractions for each parcel for both study years can be found in Appendix B (Table B-3 for Year 2016 and Table B-4 for Year 2030). The total internal Productions in Appendix B are more than the total internal Attractions. The difference is Attractions to external stations. These are trips between the site and non-site locations.

For the full buildout total weekday basis, there are 158,258 calculated total daily trip ends in the study area. There are a calculated 33,277 total internal Attractions. Each Attraction has a corresponding internal Production. The remaining 91,704 calculated Productions represent trips from the study area to outside the study area. Subtracting the internal attractions from total site productions, the site generates 124,981 distinct trips per weekday. Therefore, the total number of trips between the Sunhaven development and other parts of the metropolitan area are 91,704 on an average weekday, and total internal trips are 33,277.

This implies that approximately 27 percent of all trips in the study area go from one part of the study area to another. There is considerable interaction between the various sections of the study area, which makes sense because the size of the study area is large.

TRIP DISTRIBUTION

Trip distribution is the process of assigning a starting location for each inbound trip to the site and an ending location for each outbound trip. Daily, AM peak hour and PM peak hour trips are distributed separately. External trips are split between several external stations, which represent roadways approaching the study area. Total external trip

attractions are calculated as the difference between internal productions and internal attractions.

Specifically;

Total Daily A(Ext) = Total Daily P(Int) – Total Daily A(Int)
Total AM-In A(Ext) = Total AM-Out P(Int) – Total AM-In A(Int)
Total AM-Out A(Ext) = Total AM-In P(Int) – Total AM-Out A(Int)
Total PM-In A(Ext) = Total PM-Out P(Int) – Total PM-In A(Int)
Total PM-Out A(Ext) = Total PM-In P(Int) – Total PM-Out A(Int)

Where,

Daily = ADT trip generation
A = Attractions
P = Productions
Int = Internal zone
Ext = External station

The resulting external trips were then checked for reasonableness by comparing the values to those determined on the external stations in the Maricopa Association of Governments (MAG) Year 2030 traffic model.

External trips were split between external stations by direction proportional to a weighting factor. For Year 2016, the weighting factor was based on MAG Year 2016 Population and Employment Forecasts. The weighting factor for Year 2030 was calculated as a percentage of total trips on external stations as determined in the MAG projections for Year 2030 conditions. These percentages were used so that this study would be consistent with the data available to MAG. This distribution was disaggregated to the roads serving the study area as shown in Table 3 for Year 2016, and on Table 4 for Year 2030.

Table 3
Trip Distribution to External Stations
(Year 2016)
Sunhaven Traffic Impact Study

External Station	Percent
US 60, Northwest	9 %
US 60, Southeast	32 %
Lone Mountain Road, Southwest	3 %
Tillman Boulevard, Northwest	5 %
Tillman Boulevard, Southeast	14 %
203rd Avenue, North	3 %
Dove Valley Road, West	5 %
Dove Valley Road, East	10 %
187th Avenue, North	2 %
Lone Mountain Road, East	5 %
187th Avenue, South	12 %
	100%

Table 4
Trip Distribution to External Stations
(Year 2030)
Sunhaven Traffic Impact Study

External Station	Percent
US 60, Northwest	8 %
US 60, Southeast	27 %
Lone Mountain Road, Southwest	5 %
Tillman Boulevard, Northwest	6 %
Tillman Boulevard, Southeast	9 %
203rd Avenue, North	5 %
Collector D, North	2 %
Dove Valley Road, West	6 %
Dove Valley Road, East	11 %
Collector A, West	1 %
Collector A, East	3 %
187th Avenue, North	3 %
Lone Mountain Road, East	8 %
187th Avenue, South	6 %
	100%

The next step is to run the TransCAD program gravity model to create tables of trip origins and destinations. The gravity model is the most widely used trip distribution model. This model explicitly relates flows between zones to interzonal impedance to travel.

The assumption behind the gravity model is that the number of trips produced at zone i that are attracted to zone j is proportional to:

- The number of trips produced in zone i
- The number of trips attracted to zone j
- A function of the relative impedance between the zones, called impedance. For this study the impedance between zones i and j is defined as:

$$F(c_{ij}) = (1/c_{ij}) \times e^{-0.01(cij)}$$

Where, c_{ij} = travel time between zones i and j, which is distance times 60 divided by miles per hour. For external stations, a distance to the average location for trips going in that direction was added to the calculation of distance. The final step is to convert the trip matrices from the gravity model into trip matrices ready to assign to the network.

There are three trip matrices for assignment:

1. **Average Daily Traffic** - this is the daily trip table, balanced so that trips from zone i to zone j equal trips from zone j to zone i.
2. **AM Trip Table** - the trip table made with AM inbound Productions and outbound Attractions is transposed and added to the trip table made with AM outbound Productions and inbound Attractions.
3. **PM Trip Table** - the trip table made with PM inbound Productions and outbound Attractions is transposed and added to the trip table made with PM outbound Productions and inbound Attractions.

A trip length distribution chart is created from the ADT trip matrix in order to check the reasonableness of the gravity model calibration. Once a reasonable trip length distribution is achieved, the site traffic trip matrices are ready for assignment.

TRAFFIC ASSIGNMENT

Traffic assignment was performed with the use of TransCAD transportation software. Vehicle trips between each origin and destination were determined as outlined above and combined in an origin-destination (O-D) matrix in TransCAD. A graphical representation of the transportation network servicing the study area was also created in TransCAD. The flows of traffic for each O-D pair in the matrix were loaded onto the transportation

network. The number of trips assigned to a roadway is based upon the travel time each path could carry.

A User Equilibrium Capacity Restraint method was used to assign the trips within TransCAD. Capacity restraint recalculates travel time on roadways based on the volume and level of congestion on them. The program then reassigns trips using the new travel times. This is repeated up to 20 iterations to achieve an equilibrium solution. Background traffic is included for the recalculation of travel time in each iteration.

User equilibrium uses an iterative process to achieve a convergent solution in which no traveler can improve his or her travel time by shifting routes. In each iteration, network link flows are computed, which incorporate link capacity restraint effects and flow-dependent travel times. The formulation of the User Equilibrium problem as a mathematical program and the Frank-Wolf solution method employed in TransCAD are described in the TransCAD user manual, Technical Notes section in Chapter 9.

The resulting study area average daily traffic and AM and PM peak hour turns are shown on Figure 3 for Year 2016 and Figure 4 for Year 2030.

BACKGROUND TRAFFIC

Background traffic for 2030 is the amount of traffic that would be on study area roads in the future, if the proposed development were not built. Therefore, it is the traffic that travels all the way through the study area. Background traffic was derived from the ADOT Year 2002 traffic counts on US 60, and the previously mentioned MAG Model Year 2030 projection (2030 Surprise Hybrid w/ Rev Int 2030). In general, the MAG model is accepted as an accurate representation of the overall traffic condition in the metropolitan area.

To determine the background traffic for Year 2016, interpolation was applied to the Year 2030 MAG projections. The interpolation was based on the assumption that no background currently exists on the study area roads. This is reasonable for all roadways except the US 60. For US 60, interpolation was applied between the MAG projections and the Year 2002 ADOT counts.

Forecast ADT's were converted to approach volumes using the following formula:

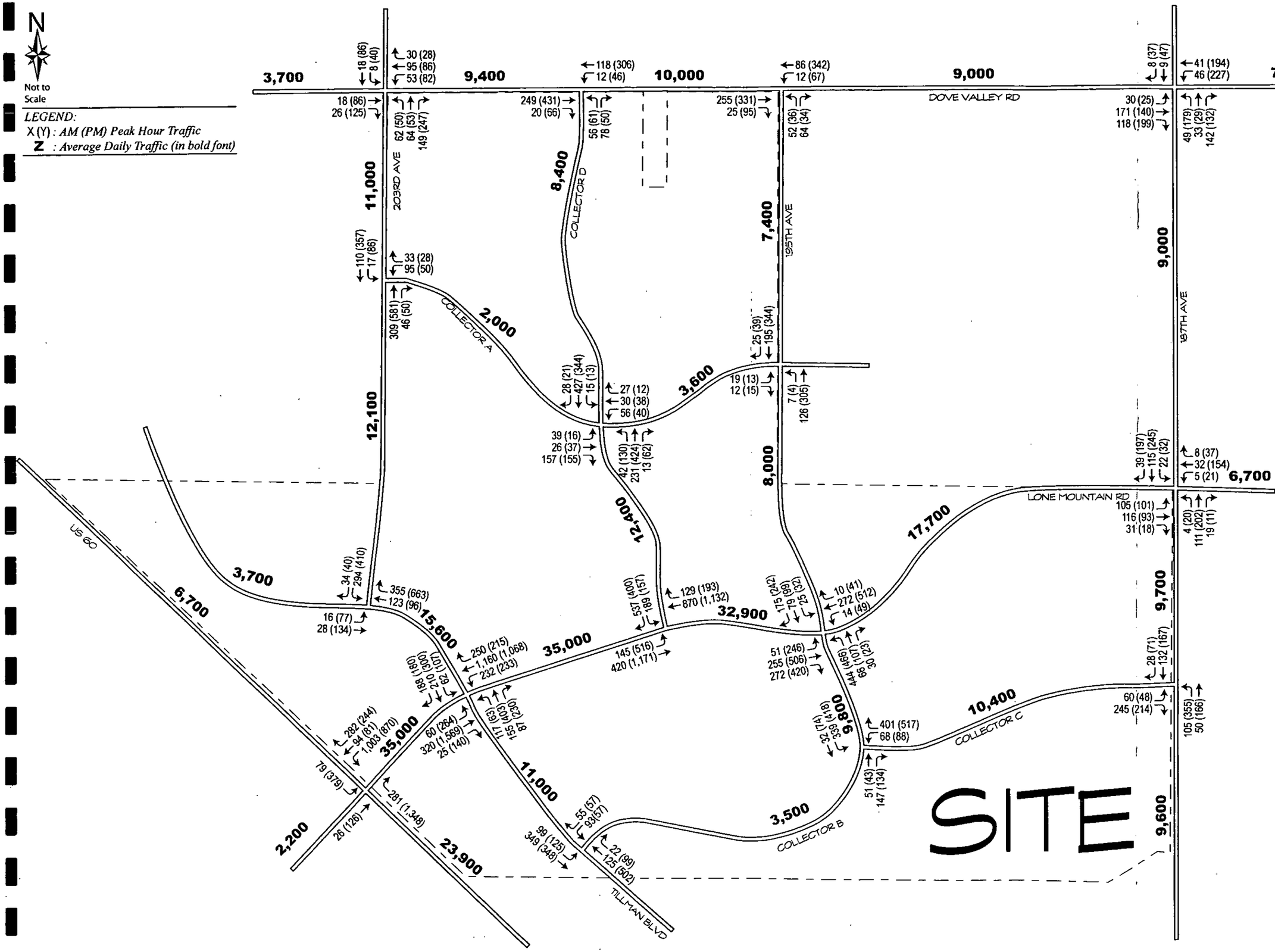
$$DDHV = AADT \times K \times D$$

Where:
AADT = forecast average annual daily traffic (vpd)
DDHV = directional design hourly volume (vph)
K = percent of AADT occurring in the peak hour, and
D = percent of peak-hour traffic in the heaviest direction.

N

Not to Scale

LEGEND:
X (Y) : *AM (PM) Peak Hour Traffic*
Z : *Average Daily Traffic (in bold font)*



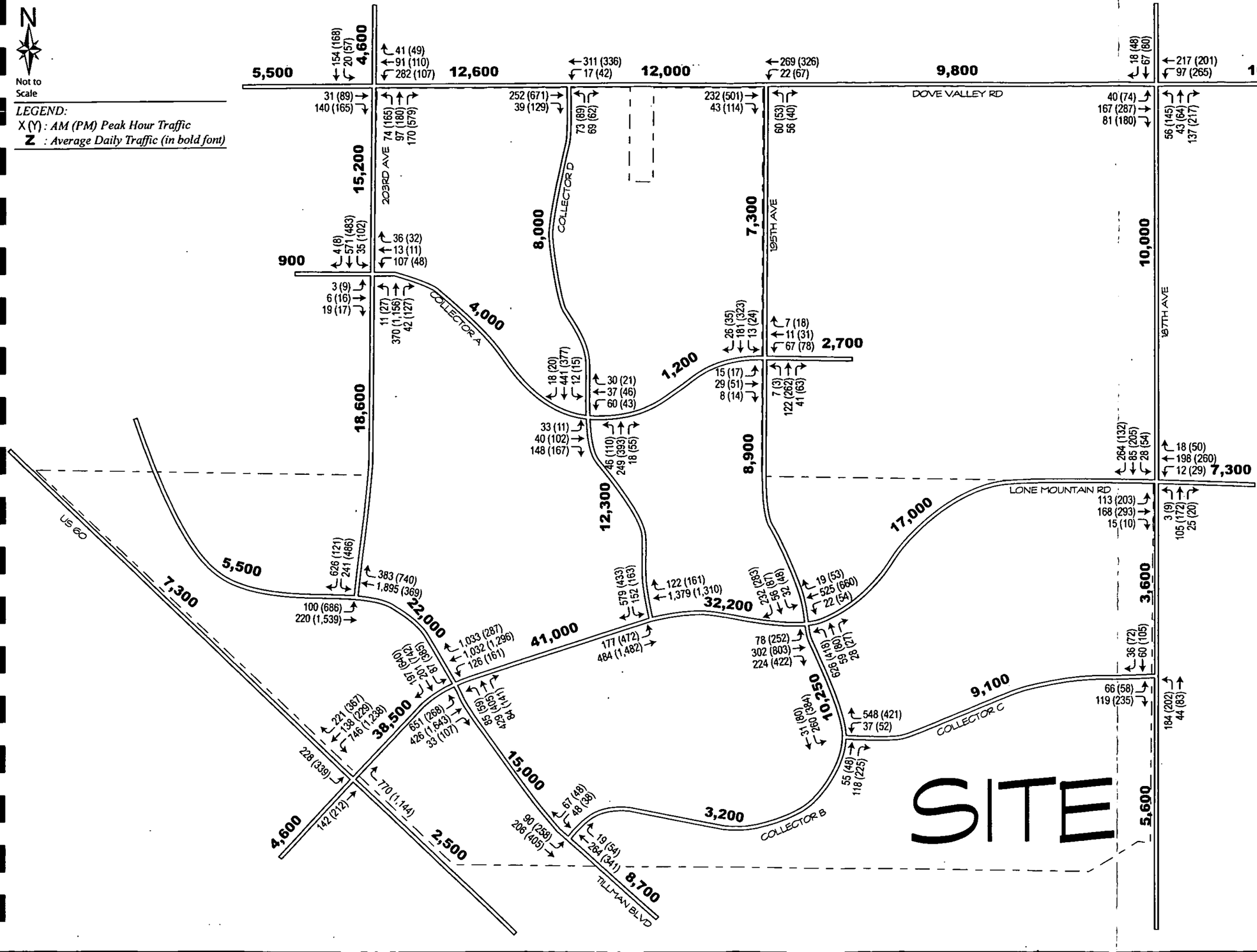
Site Traffic (Year 2016)

TASK ENGINEERING

N

Not to Scale

LEGEND:
X (Y) : *AM (PM) Peak Hour Traffic*
Z : *Average Daily Traffic (in bold font)*



Site Traffic
(Year 2030)

TADK ENGINEERING

A K value of 0.09 was used for the AM and PM peak hours. A D value of 60 percent in the peak direction was used. The peak direction is southbound and eastbound in the morning, and northbound and westbound in the evening.

To estimate total AM and PM peak hour turns, a nonlinear programming procedure was developed. This inputs the approach and departure volumes determined above and a starting estimate of percent right and left turns for each approach.

This procedure produces turn volumes, which minimizes the following objective function:

$$\text{Min. } K = \Sigma(V_E - V_C)^2 + 0.5 \times \Sigma(T_E - T_C)^2$$

Subject to: Total approach volume = Total departure volume
Approach volumes are held constant
All turns are non-negative
Approach and departure volumes are summation of turn volumes

Where: V_E, V_C = Estimated and output approach and departure volumes
T_E, T_C = Estimated and output turning volumes for each approach.

Before running the optimization routine, total approach and departure volumes are balanced. This was applied to the major intersections.

Background estimated Year 2016 and Year 2030 average daily traffic with full buildout of the development is shown on Figure 5 and Figure 6, respectively. AM and PM peak hour turns are also included.

TOTAL TRAFFIC

Total traffic is site traffic plus background traffic. Inspection of the MAG model shows that some of the Sunhaven site traffic is included in the MAG model. Since some of the site traffic is included in the MAG model background traffic, an amount equal to one-half the site traffic is subtracted from total traffic on roads with background traffic to account for this double counting. The adjustment to traffic volumes is necessary to avoid double counting site traffic that is included in the MAG projections.

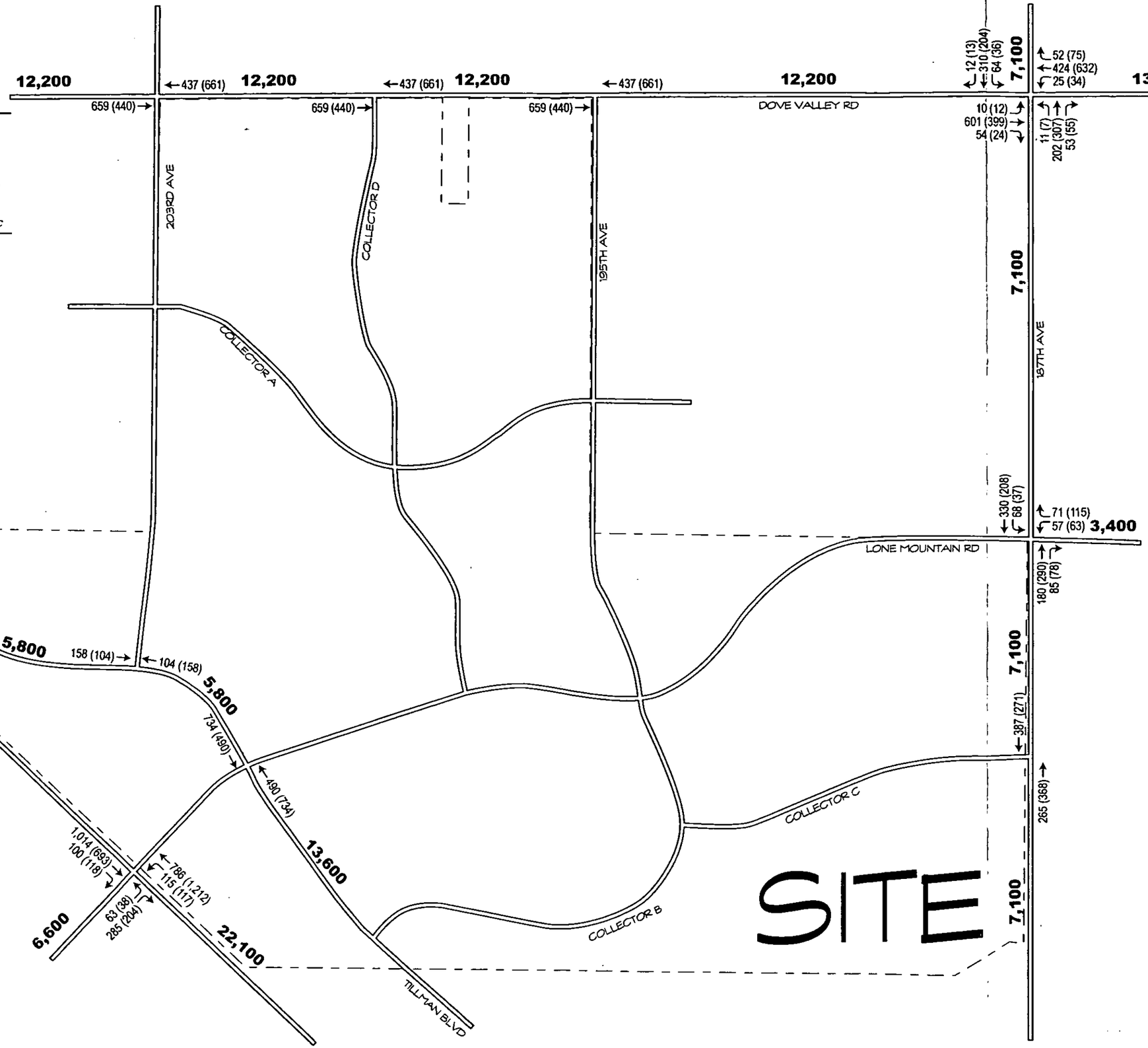
The two sites referred to in the City of Surprise comments, Wittman Ranch and the Chrysler Proving Grounds, appear to have been considered employment zones in the MAG projections. It is not clear whether the change in Wittman Ranch from employment to 1,500 residential lots would result in an increase or a decrease in traffic. At this time, there are no approved plans for redeveloping the Chrysler Proving Grounds, and the Wittman Ranch proposed General Plan Amendment has been pulled for this year. It is not certain that the redevelopment of the site would increase total Year 2030 traffic in this sector, or whether the effect would be to reshuffle development. The comments and response memorandum are found in Appendix F.

N

Not to Scale

LEGEND:
X (Y) : *AM (PM) Peak Hour Traffic*
Z : *Average Daily Traffic (in bold font)*

NOTE:
To account for Site Traffic included in MAG Projections, Total Traffic is calculated as one half Background Traffic plus Site Traffic



Sunhaven Traffic Impact Study
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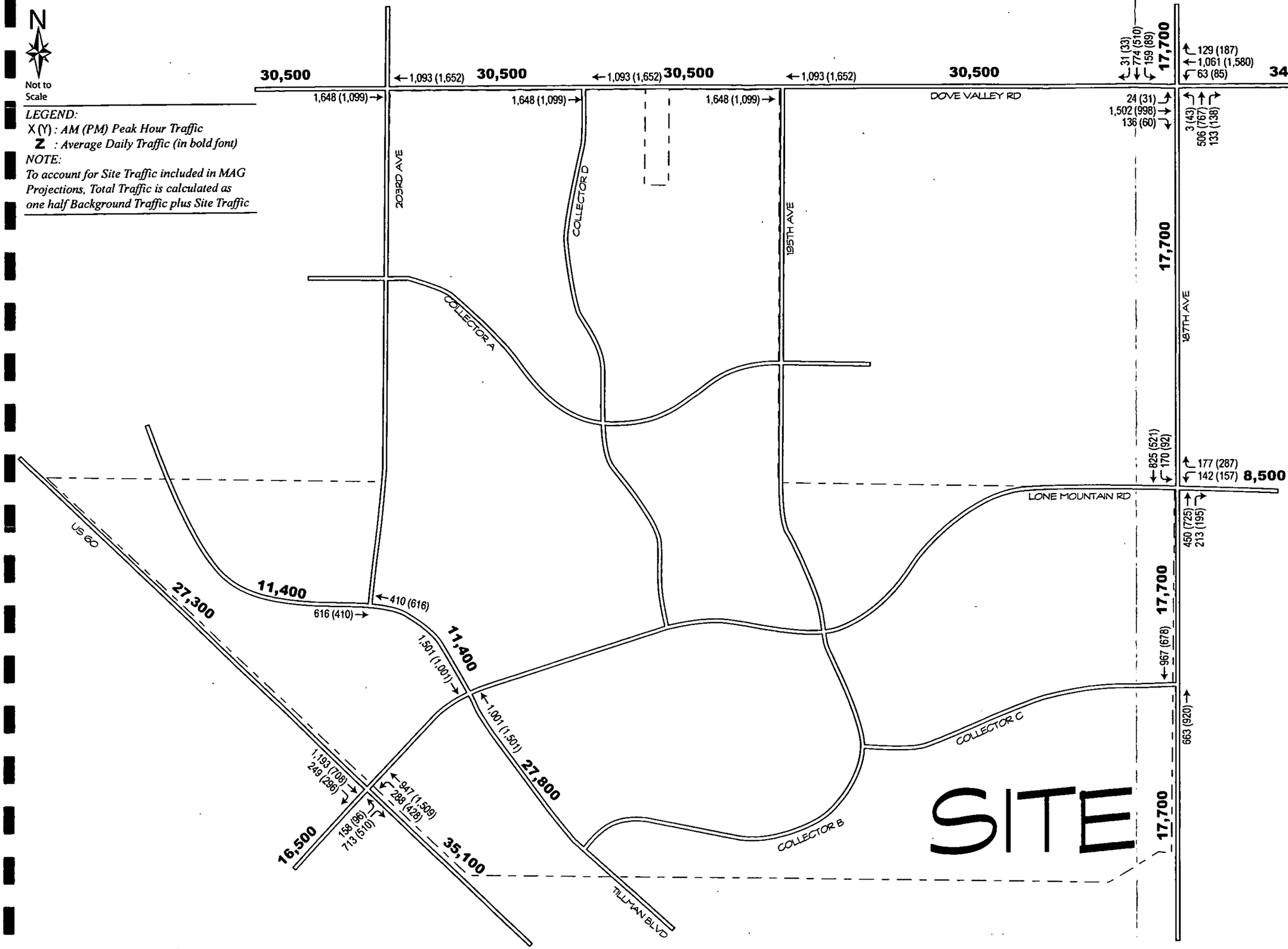
Background Traffic (Year 2016)

TASK ENGINEERING

N

Not to Scale

LEGEND:
X (Y) : *AM (PM) Peak Hour Traffic*
Z : *Average Daily Traffic (in bold font)*
NOTE:
To account for Site Traffic included in MAG Projections, Total Traffic is calculated as one half Background Traffic plus Site Traffic



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Background Traffic (Year 2030)

TASK ENGINEERING

N

Not to Scale

LEGEND:
X (Y) : *AM (PM) Peak Hour Traffic*
Z : *Average Daily Traffic (in bold font)*

Total Traffic (Year 2016)

15,550 | 16,900 | 17,200 | 16,700 | 17,550

203RD AVE 11,000 | 8,400 COLLECTOR D | 7,400 195TH AVE | 11,600 187TH AVE

DOVE VALLEY RD

2,000 COLLECTOR A | 3,600

12,100 | 7,000 | 10,100

LONE MOUNTAIN RD

US 60

7,650 | 12,400 | 17,700

22,350 | 13,600 | 35,000 | 32,900 | 11,950

19,100 | 9,800 | 10,400 COLLECTOR C

3,500 COLLECTOR B

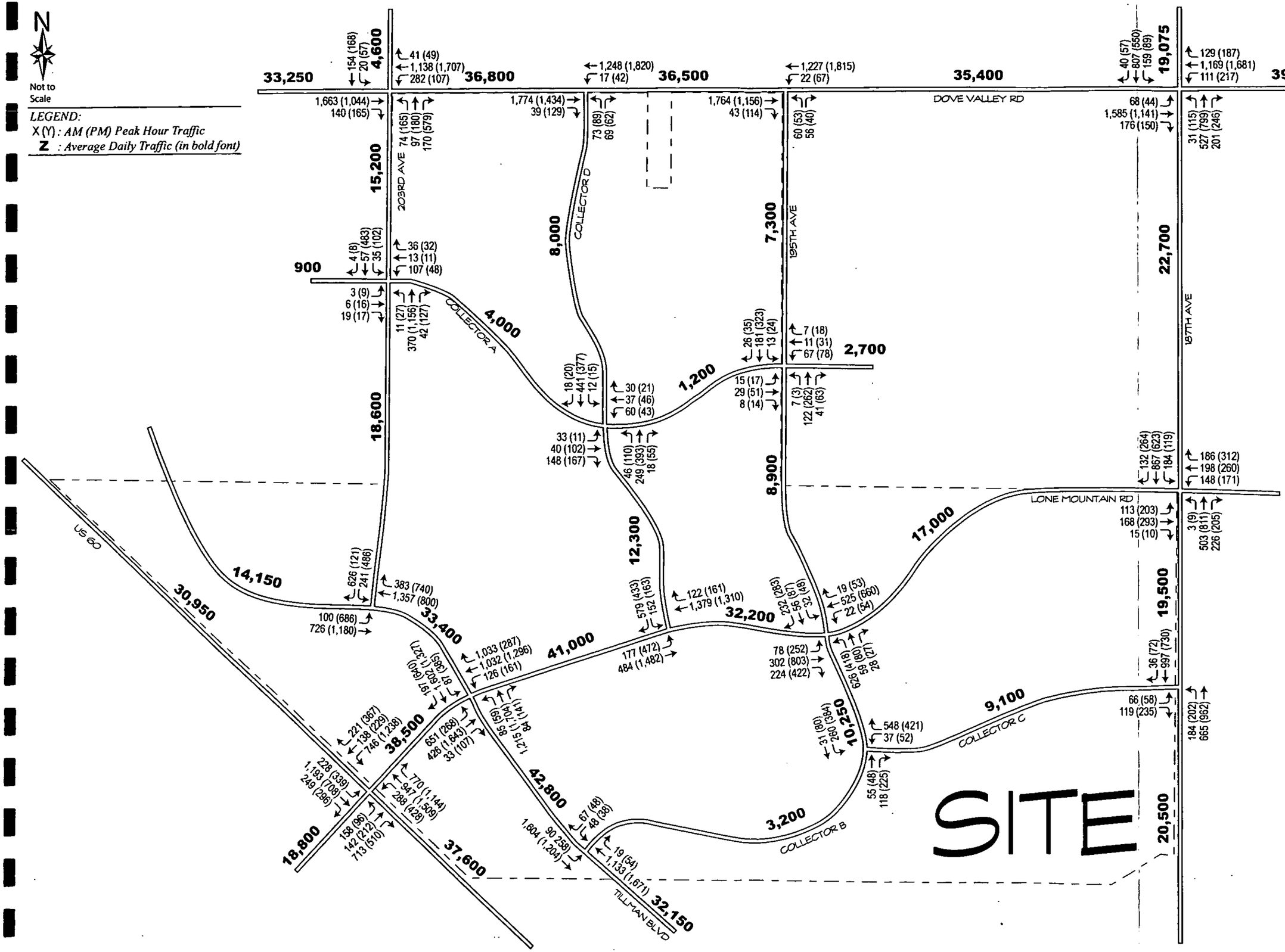
34,050 | 11,900

TILLMAN BLVD

SITE

Not to Scale

LEGEND:
X (Y) : *AM (PM) Peak Hour Traffic*
Z : *Average Daily Traffic (in bold font)*



Total Traffic (Year 2030)

TASK ENGINEERING

Within the site, site traffic is used to estimate volumes and turns on collector streets because this level of road network is not included in the MAG model.

Total traffic projections, as well as AM and PM peak hour volumes, are shown on Figure 7 for Year 2016 and on Figure 8 for Year 2030.

TRAFFIC ANALYSIS

The critical intersections were analyzed using the methodologies presented in the *Highway Capacity Manual, 2000 Edition*, and were evaluated using *Synchro* (version 6). Capacity analysis was completed for both AM and PM peak hours for total Year 2030 traffic including full site buildout conditions.

Unsignalized intersections were analyzed as STOP sign controlled intersections using the unsignalized intersection portion of Synchro. The LOS of the most difficult turning movement was reported for unsignalized intersections. Usually, this is the left turn from the minor street or access drive. The LOS for unsignalized intersections is reported in Table 5.

Table 5
Level of Service Criteria for Unsignalized Intersections
Sunhaven Traffic Impact Study

Level of Service	Control Delay (sec./veh.)
A	≤ 10.0
B	> 10.0 and ≤ 15.0
C	> 15.0 and ≤25.0
D	> 25.0 and ≤ 35.0
E	> 35.0 and ≤ 50.0
F	>50.0

Source: *Exhibit 17-2, Highway Capacity Manual 2000*, Transportation Research Board.

For signalized intersections, a peak hour factor (PHF) of 0.92 was used. This represents an average amount of traffic peaking within the peak hour. The analysis used a variable cycle length for the study intersections based on the optimization routine of the Synchro software.

Signalized intersection analysis is based on control delay. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Table 6 presents the LOS criteria for signalized intersection analysis.

Table 6
Level of Service Criteria For Signalized Intersections
Sunhaven Traffic Impact Study

Level of Service	Control Delay (sec./veh.)
A	≤ 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤35.0
D	> 35.0 and ≤ 55.0
E	> 55.0 and ≤ 80.0
F	> 80.0

Source: Exhibit 16-2, *Highway Capacity Manual 2000*, Transportation Research Board.

For signalized intersections, the average LOS for all vehicles entering the intersection during the peak hour is shown.

Figure 9 and Figure 10 shows the projected LOS for the AM and PM peak hours for Year 2016 and Year 2030, respectively. It can be seen that all unsignalized and signalized intersections operate at an LOS of D or better, with a few exceptions.

N

Not to Scale

LEGEND:
X/Y : AM/PM Level of Service (LOS)
o| : Stop Control (LOS for the most difficult movement shown)
: Traffic Signal
: Turn Lanes
: Channelized Turn Lane

A/B
D/D
D/C
C/C
DOVE VALLEY RD
203RD AVE
COLLECTOR D
195TH AVE
187TH AVE
C/C
COLLECTOR A
B/B
C/C
C/C
LONE MOUNTAIN RD
B/D
B/C
C/C
C/D
B/B
B/B
COLLECTOR C
C/D
A/A
COLLECTOR B
US 60
TILLMAN BLVD

SITE

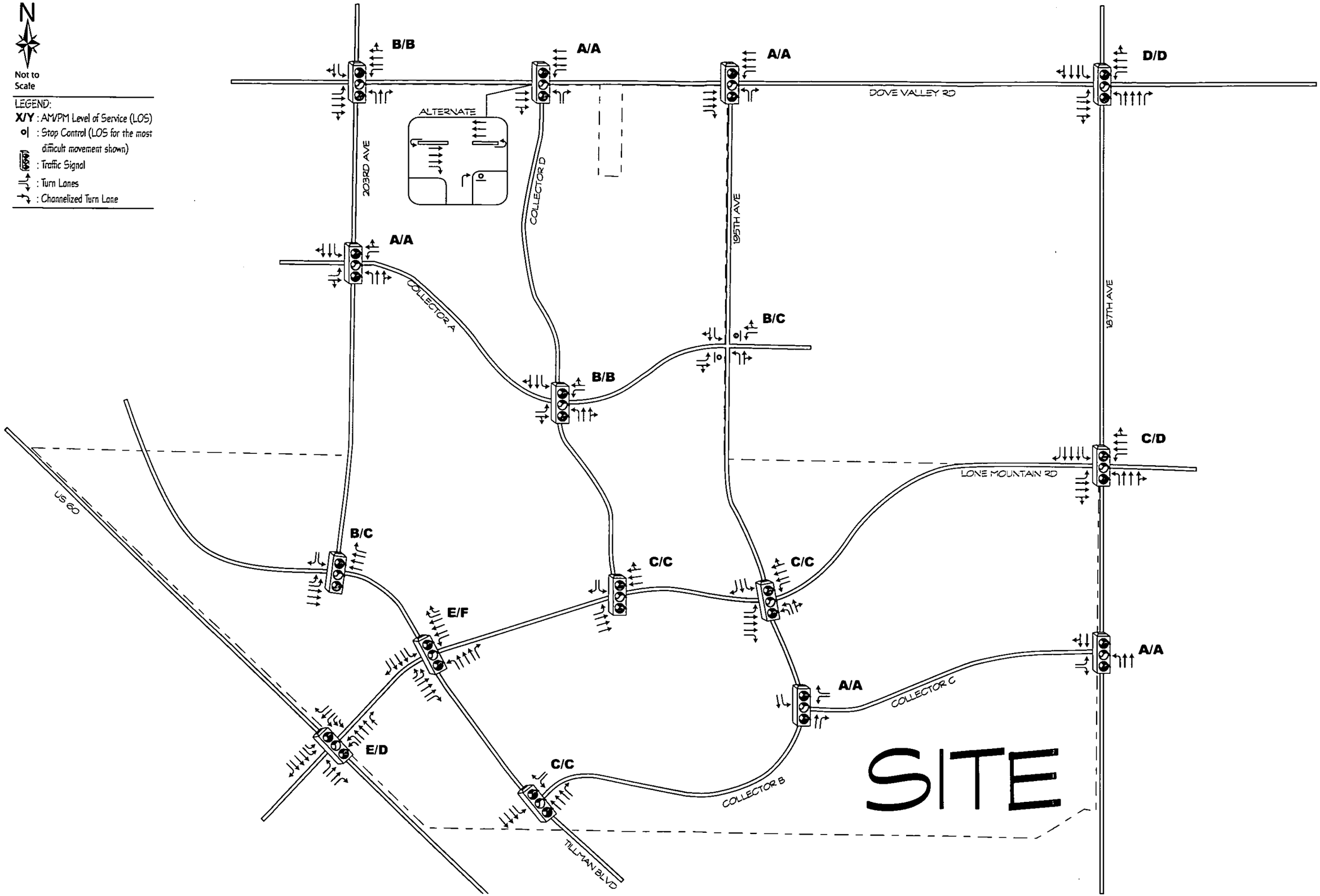
Level of Service and Recommendations
(Year 2016)

TASK ENGINEERING

N

Not to Scale

LEGEND:
X/Y : AM/PM Level of Service (LOS)
: Stop Control (LOS for the most difficult movement shown)
: Traffic Signal
: Turn Lanes
: Channelized Turn Lane



Level of Service and Recommendations
(Year 2030)

TASK ENGINEERING

The signalized intersection at Tillman Boulevard and Lone Mountain Road has an LOS F in the peak hour. This only occurs during the PM peak hour for Year 2030 conditions for the northeast bound through movement and the southeast bound left turn movement. It is primarily caused by the high volume of through traffic on Lone Mountain Road, which creates a bottleneck near the US 60. The signalized intersection of US 60 at Lone Mountain Road operates at an LOS C in the AM peak hour and an LOS D in the PM peak hour for Year 2016 and LOS E in the AM peak hour and an LOS D in the PM peak hour for Year 2030.

Alternate routes are available for this traffic, which can potentially alleviate this condition especially considering that all other signalized intersections operate at an LOS D or better.

Synchro worksheet summaries are included in Appendix A.

TRAFFIC SIGNAL WARRANT ANALYSIS

The Maricopa Department of Transportation (MCDOT) has adopted guidelines for determining if traffic signals are warranted based on estimates of average daily traffic (ADT). These are established by MCDOT Policy/Procedure Guideline 4-4.6. These guidelines extrapolate the traffic signal warrants of the Manual on Uniform Traffic Control Devices (MUTCD) to estimates of total daily volumes. The guidelines are found in Appendix C.

Most study intersections will meet the warrants based on the high volume of traffic projected on the arterial roadways. However, a few collector road intersections do not meet the warrants. Based on these guidelines the following site intersections do not meet the warrants by the respective study year.

Year 2016
The following locations are anticipated to meet traffic signal warrants by 2016

- Dove Valley Parkway/203rd Avenue
- Dove Valley Parkway/187th Avenue
- Tillman Boulevard/203rd Avenue
- Grand Avenue (US 60)/Lone Mountain Road
- Tillman Boulevard/Lone Mountain Road
- Lone Mountain Road/Collector D
- Lone Mountain Road/195th Avenue
- Lone Mountain Road/187th Avenue
- Tillman Boulevard/Collector B
- Collector B/Collector C
- 187th Avenue/Collector C

Additionally, the intersection of Collector A/Collector D is recommended to be controlled with all-way STOP sign control based on the approach volumes.

Year 2030
For Year 2030, the following additional intersections are anticipated to meet traffic signal warrants:

- Dove Valley Parkway/Collector D (Could also be an unsignalized intersection with U-turns to replace left turns)
- Dove Valley Parkway/195th Avenue
- 203rd Avenue/Collector A
- Collector A/Collector D

DESIGN ISSUES

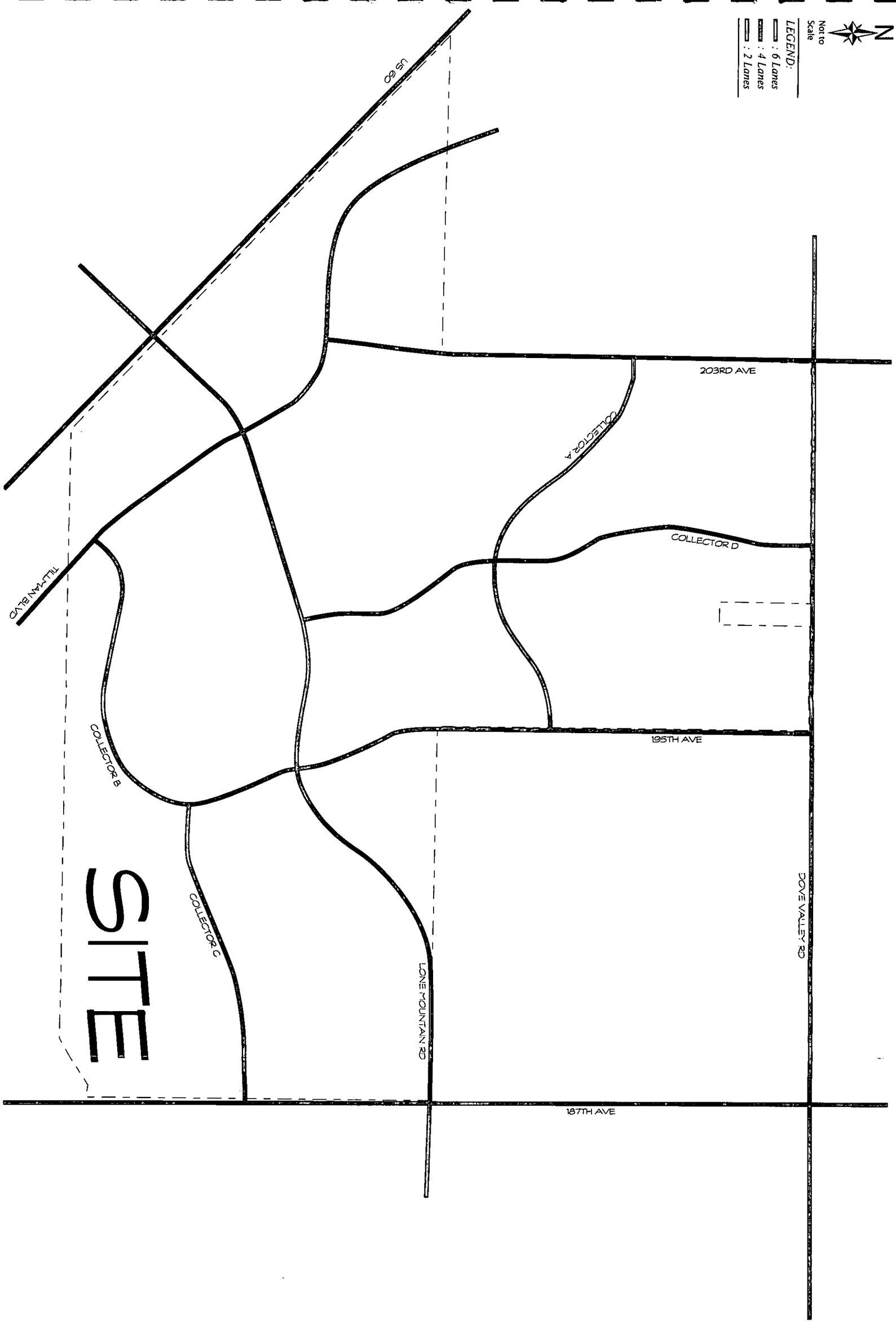
The need for deceleration lanes into the proposed site has been evaluated in this report using the City of Surprise procedures for right turn deceleration lane warrants at unsignalized and signalized intersections. The City of Surprise right turn lane criteria require a right turn deceleration lane when there are 40 vph for unsignalized intersections and 100 vph for signalized intersections

Based on these guidelines the following intersections warrant right turn lanes for Year 2016 conditions:

- Dove Valley Road at 203rd Avenue – northbound to eastbound movement
- Dove Valley Road at 195th Avenue – eastbound to southbound movement
- Dove Valley Road at 187th Avenue, northbound to eastbound
- 203rd Avenue at Tillman Boulevard, all approaches
- Lone Mountain Road at Tillman Boulevard, all approaches
- US 60 at Lone Mountain Road, all approaches (the northwest bound to northeast bound right turn lane is recommended to be channelized)
- Lone Mountain Road at 195th Avenue, eastbound to southbound and southbound to westbound.

Based on Year 2030 conditions, an additional right turn deceleration lane is warranted at the intersection of Lone Mountain Road at 187th Avenue (southbound to westbound).

Various additional lane improvements are also recommended at the signalized study area intersections as shown on Figure 9 for Year 2016 and on Figure 10 for Year 2030. Several locations are recommended to have dual turn lanes or channelized turn lanes as depicted on the figures and detailed in the RECOMMENDATIONS section. Roadway lane configurations based on traffic needs have also been detailed on Figures 11 and 12 for Year 2016 and Year 2030, respectively.



Sunhaven Traffic Impact Study

TAK ENGINEERING

Lane Recommendations
(Year 2016)

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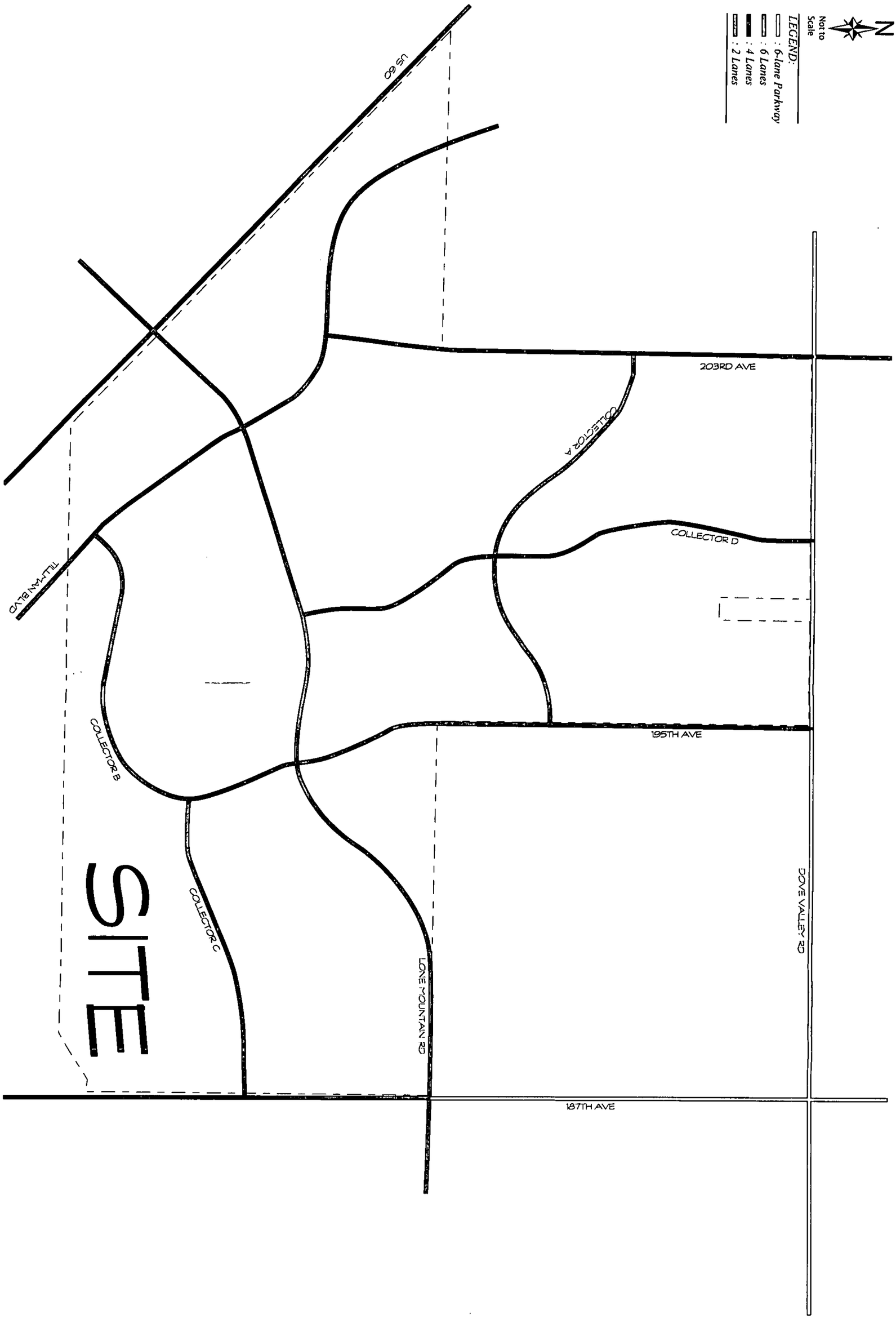


Sunhaven Traffic Impact Study

A major intersection serving the site is at Lone Mountain Road and US 60. Much of the traffic will use this intersection to access the US 60 to travel towards the Metropolitan Phoenix area. As stated before there are no plans for an interchange at this location. This intersection is projected to operate adequately with the installation of a triple left turn lane for the southwest bound Lone Mountain Road to southeast bound US 60 turning movement and one for the south-westbound through movement on Lone Mountain Road.

Dual westbound to northbound right turn lanes are recommended in 2030 at Lone Mountain Road/Tillman Boulevard.

RECOMMENDATIONS

The proposed development is a mixed land use site that will generate an estimated 158,258 total trip ends per day, with 10,711 morning peak hour trips and 15,959 evening peak hour trips at full buildout. The traffic disperses in such a way that it can be accommodated on the internal roadways and connecting arterial system with the following recommended improvements. Recommendations are summarized on Figure 9 for Year 2016 and on Figure 10 for Year 2030. Recommended cross sections are included in Appendix D.

Year 2016

- US 60 is planned to be a full six-lane Principal Arterial by Year 2030. An at-grade signalized intersection is planned at the realigned Lone Mountain Road/US 60 intersection.

- Tillman Boulevard is planned as a Major Arterial in the future. It will have a six-lane cross section and planned right of way of 136 feet. It will run parallel to US 60 and continues north until it connects with 211th Avenue, a north-south Minor Arterial.

- Dove Valley Road is planned as a Parkway that extends east and west and intersects the US 60 west of the site. It has a planned right of way of 200 feet (100 feet per half street) and an ultimate configuration of six through lanes. An interim cross section of two lanes in each direction is feasible.

- One Hundred Eighty Seventh Avenue south of Lone Mountain Road is planned as a Minor Arterial in the future. It is planned to have a four-lane cross section. The planned right of way is a 55-foot wide half street.

- On-hundred Eighty Seventh Avenue north of Lone Mountain Road is planned as a Parkway in the future. It is planned to have six through lanes and a 200-foot total right of way width (100 feet per half street). An interim cross section of one lane in each direction is feasible.

- Lone Mountain Road as it enters the Sunhaven site will curve to the southwest and intersect the US 60. It is planned as a six-lane Major Arterial through the vicinity of the site. It is planned to have 136 feet right of way.

- Two Hundred Third Avenue is a section line road and should be built as a Minor Arterial on 110 feet of right of way. 203rd Avenue is planned to extend north of Dove Valley Road, but will terminate at Tillman Boulevard to the south.

- One Hundred Ninety Fifth Avenue is planned to be built as a Minor Arterial on a 55-foot half street right of way. It is not planned to extend north of Dove Valley Road. It turns into Collector B to the south. An interim cross section of one lane in each direction is feasible.

- Collectors A, B, and C are all planned Residential Collector roads. They loop around the site and serve the site by distributing the site traffic to the arterial roads. The planned right of way is 80 feet. Collector A is not anticipated to extend beyond the site for Year 2016 conditions. Collector A will extend further to the east and west by Year 2030 when the surrounding has been built out.

- Collector D is planned as a "High Volume Collector" with four lanes and 105 feet of right of way.

- The following intersections are recommended to have traffic signal control by Year 2016:

    - Dove Valley Parkway/203rd Avenue
    - Dove Valley Parkway/187th Avenue
    - Tillman Boulevard/203rd Avenue
    - Grand Avenue (US 60)/Lone Mountain Road
    - Tillman Boulevard/Lone Mountain Road
    - Lone Mountain Road/Collector D
    - Lone Mountain Road/195th Avenue
    - Lone Mountain Road/187th Avenue
    - Tillman Boulevard/Collector B
    - Collector B/Collector C
    - 187th Avenue/Collector C

- Traffic signals should not be installed until a Needs Study has been conducted as described in the Traffic Signal Warrants section of the *Manual on Uniform Traffic Control Devices (MUTCD)*.

- For Year 2016 conditions, the following unsignalized intersections warrant right turn lanes:

    - Dove Valley Road at 203rd Avenue – northbound to eastbound movement
    - Dove Valley Road at 195th Avenue – eastbound to southbound movement
    - Dove Valley Road at 187th Avenue, northbound to eastbound
    - 203rd Avenue at Tillman Boulevard, all approaches
    - Tillman Boulevard at Lone Mountain Road, all approaches
    - US 60 at Lone Mountain Road, all approaches (the northwest bound to northeast bound right turn lane is recommended to be channelized)
    - Lone Mountain Road at 195th Avenue, eastbound to southbound and southbound to westbound.

- Additional lane improvements for the signalized intersections can be seen on Figure 9.

- The following locations need turn lane improvements for Year 2016 conditions:

    - US 60/Lone Mountain Road:
        - Dual left turn lanes for southwest bound to southeast bound movement
        - Channelized right turn lane for northwest bound to northeast bound movement
    - Lone Mountain Road/ Collector B:
        - Dual left turn lanes for northbound to westbound movement

- STOP sign control and exclusive left and right turn lanes are recommended at all internal site intersections.

Year 2030

- The intersection of Lone Mountain Road/US 60 will remain an at-grade signalized intersection, but an additional improvement is needed for this intersection. It is recommended to install a triple left turn lane for the southwest bound to southeast bound movement with only one through lane to the continuation of Lone Mountain Road southwest of US 60.

- Additional improvements are recommended on Tillman Road at its intersection with Lone Mountain Road. Although heavy traffic flows are anticipated at this intersection, the surrounding road network provides alternate less congested routes.

- Dove Valley Road is also planned to be widened to six through lanes (by others).

- One Hundred Eighty Seventh Avenue is planned to be widened to four through lanes (by others).

- Collector A is planned to extend east and west beyond the site for Year 2030 conditions.

- The following additional intersections are recommended have traffic signal control by Year 2030:
    - Dove Valley Parkway/Collector D (Could also be an unsignalized intersection with U-turns to replace left turns)
    - Dove Valley Parkway/195th Avenue
    - 203rd Avenue/Collector A
    - Collector A/Collector D

- Although the intersection of Dove Valley Road and Collector D is recommended to be signalized, if Dove Valley Road is constructed as a parkway, then it will handle left turns by substituting a right turn and a downstream U-turn for the direct left turn. In this way, left turns from Collector D will be accommodated in full build out. In either case we believe that northbound to westbound and westbound to southbound movements will be accommodated by the ultimate design of Dove Valley Road/Collector D

- Additional lane improvements for the signalized intersections can be seen on Figure 10.

- The following additional turn lane improvements are recommended for Year 2030 conditions:

    - US 60/Lone Mountain Road:
        - Dual left turn lanes for northwest bound to southwest bound movement, and southeast bound to northeast bound movement
        - Triple left turn lanes for southwest bound to southeast bound movement

    - Tillman Boulevard/Lone Mountain Road:
        - Dual left turn lanes for southeast bound to northeast bound movement, and northeast bound to northwest bound movement
        - Dual right turn lanes for southwest bound to northwest bound movement

    - Tillman Boulevard/203rd Avenue:
        - Dual left turn lanes for eastbound to northbound movement

APPENDIX A:

CAPACITY SUMMARIES

Movement												
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.90		1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1803		1770	1667		1770	1782		1770	1837	
Flt Permitted	0.46	1.00		0.54	1.00		0.50	1.00		0.45	1.00	
Satd. Flow (perm)	859	1803		997	1667		938	1782		834	1837	
Volume (vph)	105	116	31	60	32	75	4	235	95	79	387	39
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	111	122	33	63	34	79	4	247	100	83	407	41
RTOR Reduction (vph)	0	13	0	0	69	0	0	11	0	0	3	0
Lane Group Flow (vph)	111	142	0	63	44	0	4	336	0	83	445	0
Turn Type	pm+pt			pm+pt			Perm			pm+pt		
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	21.2	12.4		17.0	10.3		47.8	47.8		58.9	58.9	
Effective Green, g (s)	23.2	13.4		19.0	11.3		48.8	48.8		59.9	59.9	
Actuated g/C Ratio	0.26	0.15		0.21	0.13		0.54	0.54		0.67	0.67	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	321	268		277	209		509	966		639	1223	
v/s Ratio Prot	c0.04	c0.09		0.02	0.07			0.19		0.01	c0.24	
v/s Ratio Perm	0.05			0.03			0.00			0.07		
v/c Ratio	0.35	0.53		0.23	0.21		0.01	0.35		0.13	0.36	
Uniform Delay, d1	26.6	35.4		29.1	35.3		9.5	11.6		5.9	6.6	
Progression Factor	1.40	1.35		1.00	1.00		0.80	0.78		2.01	2.12	
Incremental Delay, d2	0.6	2.0		0.4	0.5		0.0	1.0		0.1	0.8	
Delay (s)	37.7	49.9		29.5	35.8		7.6	10.0		11.9	14.9	
Level of Service	D	D		C	D		A	B		B	B	
Approach Delay (s)		44.8			33.6			10.0			14.4	
Approach LOS		D			C			B			B	

Intersection Summary			
HCM Average Control Delay	21.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	51.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1770	1583	1770	1863	1848	
Flt Permitted	0.95	1.00	0.41	1.00	1.00	
Satd. Flow (perm)	1770	1583	758	1863	1848	
Volume (vph)	69	245	105	290	453	28
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	73	258	111	305	477	29
RTOR Reduction (vph)	0	229	0	0	1	0
Lane Group Flow (vph)	73	29	111	305	505	0
Turn Type		Perm	pm+pt			
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	9.0	9.0	73.0	73.0	63.5	
Effective Green, g (s)	10.0	10.0	74.0	74.0	64.5	
Actuated g/C Ratio	0.11	0.11	0.82	0.82	0.72	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	197	176	696	1532	1324	
v/s Ratio Prot	0.04		0.01	c0.16	c0.27	
v/s Ratio Perm		0.16	0.12			
v/c Ratio	0.37	0.16	0.16	0.20	0.38	
Uniform Delay, d1	37.1	36.2	2.1	1.7	5.0	
Progression Factor	1.00	1.00	1.00	1.00	0.59	
Incremental Delay, d2	1.2	0.4	0.1	0.3	0.8	
Delay (s)	38.3	36.6	2.3	2.0	3.7	
Level of Service	D	D	A	A	A	
Approach Delay (s)	37.0			2.1	3.7	
Approach LOS	D			A	A	

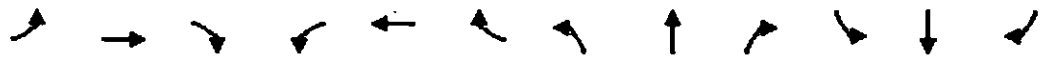
HCM Average Control Delay	12.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	47.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3464		1770	3483		1770	1863	1583	1770	1816	
Flt Permitted	0.33	1.00		0.26	1.00		0.32	1.00	1.00	0.61	1.00	
Satd. Flow (perm)	614	3464		487	3483		601	1863	1583	1143	1816	
Volume (vph)	25	686	113	48	444	52	36	218	124	16	315	64
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	26	722	119	51	467	55	38	229	131	17	332	67
RTOR Reduction (vph)	0	12	0	0	8	0	0	0	131	0	9	0
Lane Group Flow (vph)	26	829	0	51	514	0	38	229	0	17	390	0
Turn Type	pm+pt			pm+pt			pm+pt		NA	pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	36.0	36.0		37.4	37.4		16.0	16.0	0.0	30.0	30.0	
Effective Green, g (s)	37.0	37.0		38.4	38.4		17.0	17.0	0.0	31.0	31.0	
Actuated g/C Ratio	0.41	0.41		0.43	0.43		0.19	0.19	0.00	0.34	0.34	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	304	1424		285	1486		173	352	0	523	626	
v/s Ratio Prot	0.00	c0.24		0.01	c0.15		0.01	c0.12		0.01	c0.22	
v/s Ratio Perm	0.03			0.07			0.03			0.00		
v/c Ratio	0.09	0.58		0.18	0.35		0.22	0.65	0.00	0.03	0.62	
Uniform Delay, d1	16.3	20.5		21.0	17.4		41.4	33.8	45.0	19.7	24.6	
Progression Factor	0.79	0.89		1.00	1.00		0.88	0.91	1.00	1.00	1.00	
Incremental Delay, d2	0.1	1.7		0.3	0.6		0.6	4.1	0.0	0.0	1.9	
Delay (s)	13.1	20.0		21.3	18.0		37.2	35.0	45.0	19.7	26.6	
Level of Service	B	B		C	B		D	C	D	B	C	
Approach Delay (s)		19.8			18.3			38.5			26.3	
Approach LOS		B			B			D			C	

HCM Average Control Delay	23.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	63.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0		3.0	3.0	3.0	3.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frt	0.99		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3519		1770	3539	1770	1583
Flt Permitted	1.00		0.42	1.00	0.95	1.00
Satd. Flow (perm)	3519		789	3539	1770	1583
Volume (vph)	552	22	99	908	93	55
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	581	23	104	956	98	58
RTOR Reduction (vph)	3	0	0	0	0	58
Lane Group Flow (vph)	601	0	104	956	98	0
Turn Type			Perm			NA
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	46.2		46.2	46.2	5.8	0.0
Effective Green, g (s)	47.2		47.2	47.2	6.8	0.0
Actuated g/C Ratio	0.79		0.79	0.79	0.11	0.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	2768		621	2784	201	0
v/s Ratio Prot	0.17			c0.27	c0.06	
v/s Ratio Perm			0.13			
v/c Ratio	0.22		0.17	0.34	0.49	0.00
Uniform Delay, d1	1.6		1.6	1.9	25.0	30.0
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2		0.6	0.3	1.9	0.0
Delay (s)	1.8		2.2	2.2	26.8	30.0
Level of Service	A		A	A	C	C
Approach Delay (s)	1.8			2.2	28.0	
Approach LOS	A			A	C	

Intersection Summary			
HCM Average Control Delay	4.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	36.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor		0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frt		0.99		1.00	0.99		1.00	1.00	0.85	1.00	1.00	
Flt Protected		1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		3520		1770	3508		1770	1863	1583	1770	1863	
Flt Permitted		1.00		0.32	1.00		0.75	1.00	1.00	0.71	1.00	
Satd. Flow (perm)		3520		603	3508		1388	1863	1583	1318	1863	
Volume (vph)	0	668	26	53	484	30	62	64	149	8	18	0
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	703	27	56	509	32	65	67	157	8	19	0
RTOR Reduction (vph)	0	2	0	0	2	0	0	0	46	0	0	0
Lane Group Flow (vph)	0	728	0	56	539	0	65	67	111	8	19	0
Turn Type	Perm			pm+pt			Perm		pt+ov	Perm		
Protected Phases		2		1	6			8	8 1		4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		50.8		72.8	72.8		9.2	9.2	31.2	9.2	9.2	
Effective Green, g (s)		51.8		73.8	73.8		10.2	10.2	32.2	10.2	10.2	
Actuated g/C Ratio		0.58		0.82	0.82		0.11	0.11	0.36	0.11	0.11	
Clearance Time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2026		741	2877		157	211	566	149	211	
v/s Ratio Prot		c0.21		0.02	0.15			0.04	c0.10		0.01	
v/s Ratio Perm				0.05			c0.05			0.01		
v/c Ratio		0.36		0.08	0.19		0.41	0.32	0.20	0.05	0.09	
Uniform Delay, d1		10.2		3.4	1.7		37.1	36.7	20.0	35.6	35.7	
Progression Factor		1.00		1.71	1.52		0.74	0.73	0.23	1.00	1.00	
Incremental Delay, d2		0.5		0.0	0.1		1.7	0.9	0.2	0.2	0.2	
Delay (s)		10.7		5.8	2.8		29.1	27.7	4.7	35.7	35.9	
Level of Service		B		A	A		C	C	A	D	D	
Approach Delay (s)		10.7			3.1			15.5			35.9	
Approach LOS		B			A			B			D	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	42.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

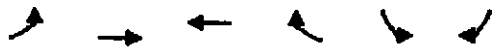
Movement	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.90		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1676		1770	1863
Flt Permitted	0.95	1.00	1.00		0.63	1.00
Satd. Flow (perm)	1770	1583	1676		1167	1863
Volume (vph)	68	401	51	147	339	32
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	72	422	54	155	357	34
RTOR Reduction (vph)	0	243	89	0	0	0
Lane Group Flow (vph)	72	179	120	0	357	34
Turn Type		Perm			Perm	
Protected Phases	8		2			6
Permitted Phases		8			6	
Actuated Green, G (s)	16.0	16.0	16.0		16.0	16.0
Effective Green, g (s)	17.0	17.0	17.0		17.0	17.0
Actuated g/C Ratio	0.42	0.42	0.42		0.42	0.42
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Lane Grp Cap (vph)	752	673	712		496	792
v/s Ratio Prot	0.04		0.12			0.02
v/s Ratio Perm		0.27			c0.31	
v/c Ratio	0.10	0.27	0.17		0.72	0.04
Uniform Delay, d1	6.9	7.5	7.1		9.5	6.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.3	1.0	0.5		8.7	0.1
Delay (s)	7.1	8.4	7.6		18.2	6.8
Level of Service	A	A	A		B	A
Approach Delay (s)	8.2		7.6			17.3
Approach LOS	A		A			B

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.95		0.97	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.95		1.00	0.85	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97		0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	3520		3433	1716		1770	1583	1583
Flt Permitted	0.51	1.00	1.00	0.58	1.00		0.95	0.97		0.69	1.00	1.00
Satd. Flow (perm)	955	5085	1583	1080	3520		3433	1716		1288	1583	1583
Volume (vph)	51	255	272	14	272	10	444	66	30	25	79	175
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	54	268	286	15	286	11	467	69	32	26	83	184
RTOR Reduction (vph)	0	0	127	0	2	0	0	22	0	0	0	158
Lane Group Flow (vph)	54	268	159	15	295	0	467	79	0	26	83	26
Turn Type	pm+pt		Perm	Perm			Prot			pm+pt		Perm
Protected Phases	5	2			6		3	8		7	4	
Permitted Phases	2		2	6						4		4
Actuated Green, G (s)	49.1	49.1	49.1	41.0	41.0		17.0	26.1		14.7	11.9	11.9
Effective Green, g (s)	50.1	50.1	50.1	42.0	42.0		18.0	27.1		16.7	12.9	12.9
Actuated g/C Ratio	0.56	0.56	0.56	0.47	0.47		0.20	0.30		0.19	0.14	0.14
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	578	2831	881	504	1643		687	517		259	227	227
v/s Ratio Prot	0.01	0.05			0.08		c0.14	0.06		0.00	0.05	
v/s Ratio Perm	0.05		0.18	0.01						0.01		0.12
v/c Ratio	0.09	0.09	0.18	0.03	0.18		0.68	0.15		0.10	0.37	0.12
Uniform Delay, d1	9.2	9.3	9.8	13.0	14.0		33.3	23.0		30.3	34.9	33.6
Progression Factor	0.44	0.41	0.44	1.10	1.09		1.00	1.00		1.00	1.01	1.10
Incremental Delay, d2	0.1	0.1	0.4	0.1	0.2		2.7	0.1		0.2	1.0	0.2
Delay (s)	4.1	3.9	4.8	14.4	15.4		36.0	23.2		30.6	36.3	37.3
Level of Service	A	A	A	B	B		D	C		C	D	D
Approach Delay (s)		4.3			15.4			33.7		36.4		
Approach LOS		A			B			C		D		

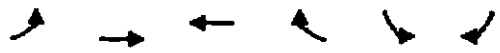
HCM Average Control Delay	20.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	40.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	3539	3539	1583	1770	1583
Flt Permitted	0.33	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	608	3539	3539	1583	1770	1583
Volume (vph)	16	206	175	355	294	34
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	17	217	184	374	309	36
RTOR Reduction (vph)	0	0	0	55	0	8
Lane Group Flow (vph)	17	217	184	319	309	28
Turn Type	Perm			custom		custom
Protected Phases		4		6	6	7
Permitted Phases	4		8	8		6
Actuated Green, G (s)	17.1	17.1	9.8	74.7	64.9	68.2
Effective Green, g (s)	18.1	18.1	10.8	76.7	65.9	70.2
Actuated g/C Ratio	0.20	0.20	0.12	0.85	0.73	0.78
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	122	712	425	1402	1296	1288
v/s Ratio Prot		c0.06		c0.20	0.17	0.00
v/s Ratio Perm	0.03		0.05	0.04		0.02
v/c Ratio	0.14	0.30	0.43	0.23	0.24	0.02
Uniform Delay, d1	29.5	30.6	36.8	1.2	3.9	2.2
Progression Factor	1.00	1.00	1.12	11.35	1.03	0.82
Incremental Delay, d2	0.5	0.2	0.6	0.1	0.4	0.0
Delay (s)	30.1	30.8	41.9	13.9	4.4	1.8
Level of Service	C	C	D	B	A	A
Approach Delay (s)		30.8	23.1		4.2	
Approach LOS		C	C		A	

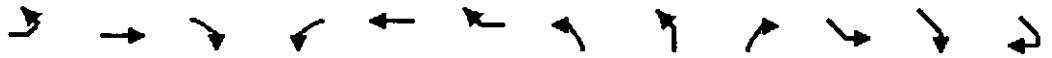
HCM Average Control Delay	18.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	34.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0		3.0	3.0
Lane Util. Factor	1.00	0.91	0.91		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	5085	4987		1770	1583
Flt Permitted	0.19	1.00	1.00		0.95	1.00
Satd. Flow (perm)	349	5085	4987		1770	1583
Volume (vph)	145	420	870	129	189	537
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	153	442	916	136	199	565
RTOR Reduction (vph)	0	0	17	0	0	15
Lane Group Flow (vph)	153	442	1035	0	199	550
Turn Type	pm+pt					pm+ov
Protected Phases	5	2	6		4	5
Permitted Phases	2					4
Actuated Green, G (s)	67.5	67.5	41.9		14.5	36.1
Effective Green, g (s)	68.5	68.5	42.9		15.5	38.1
Actuated g/C Ratio	0.76	0.76	0.48		0.17	0.42
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	622	3870	2377		305	723
v/s Ratio Prot	0.06	0.09	c0.21		0.11	c0.20
v/s Ratio Perm	0.13					0.16
v/c Ratio	0.25	0.11	0.44		0.65	0.76
Uniform Delay, d1	4.1	2.8	15.6		34.7	22.1
Progression Factor	3.32	0.85	1.05		1.00	1.00
Incremental Delay, d2	0.2	0.1	0.6		4.9	4.7
Delay (s)	14.0	2.4	16.8		39.7	26.8
Level of Service	B	A	B		D	C
Approach Delay (s)		5.4	16.8		30.2	
Approach LOS		A	B		C	

Intersection Summary			
HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	59.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	0.94	1.00	1.00	0.76	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.95	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	4990	1583	1770	3610	1583
Flt Permitted	0.18	1.00	1.00	0.49	1.00	1.00	0.21	0.95	1.00	1.00	1.00	1.00
Satd. Flow (perm)	335	5085	1583	918	5085	1583	396	4990	1583	1863	3610	1583
Volume (vph)	60	320	25	232	1160	250	117	568	87	62	839	188
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	63	337	26	244	1221	263	123	598	92	65	883	198
RTOR Reduction (vph)	0	0	26	0	0	110	0	0	73	0	0	198
Lane Group Flow (vph)	63	337	0	244	1221	153	123	598	19	65	883	0
Turn Type	pm+pt		NA	pm+pt		pm+ov	pm+pt		Perm	pm+pt		NA
Protected Phases	5	2		1	6	7	3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	43.7	38.0	0.0	53.0	43.3	50.5	21.8	17.8	17.8	28.2	21.0	0.0
Effective Green, g (s)	45.7	39.0	0.0	54.0	44.3	52.5	23.8	18.8	18.8	30.0	22.0	0.0
Actuated g/C Ratio	0.51	0.43	0.00	0.60	0.49	0.58	0.26	0.21	0.21	0.33	0.24	0.00
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	277	2204	0	664	2503	976	181	1042	331	613	882	0
v/s Ratio Prot	0.02	0.07		c0.05	c0.24	c0.02	c0.04	0.12		0.01	c0.24	
v/s Ratio Perm	0.10			0.17		0.14	0.14		0.06	0.03		
v/c Ratio	0.23	0.15	0.00	0.37	0.49	0.16	0.68	0.57	0.06	0.11	1.00	0.00
Uniform Delay, d1	11.6	15.5	45.0	8.5	15.3	8.6	27.1	32.0	28.5	20.8	34.0	45.0
Progression Factor	1.00	1.00	1.00	1.18	1.19	4.34	1.00	1.00	1.00	0.89	0.86	1.00
Incremental Delay, d2	0.4	0.1	0.0	0.3	0.1	0.1	9.7	2.3	0.3	0.1	30.6	0.0
Delay (s)	12.0	15.6	45.0	10.3	18.2	37.4	36.8	34.3	28.8	18.6	59.9	45.0
Level of Service	B	B	D	B	B	D	D	C	C	B	E	D
Approach Delay (s)		16.9			20.0			34.1		55.0		
Approach LOS		B			C			C		D		

Intersection Summary			
HCM Average Control Delay	32.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Configurations													
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	5085	1583	1770	5085	1583	1770	1863	1583	3433	1863	1583	
Flt Permitted	0.21	1.00	1.00	0.19	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (perm)	400	5085	1583	345	5085	1583	1863	1863	1583	3433	1863	1583	
Volume (vph)	79	1014	100	115	786	281	63	26	285	1003	94	282	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Adj. Flow (vph)	83	1067	105	121	827	296	66	27	300	1056	99	297	
RTOR Reduction (vph)	0	0	105	0	0	0	0	0	14	0	0	65	
Lane Group Flow (vph)	83	1067	0	121	827	296	66	27	286	1056	99	232	
Turn Type	pm+pt		NA	pm+pt		Free	pm+pt		pm+ov	Prot		pm+ov	
Protected Phases	1	6		5	2		7	4	5	3	8	1	
Permitted Phases	6			2		Free	4		4			8	
Actuated Green, G (s)	26.7	21.6	0.0	24.7	20.6	70.1	4.8	2.6	6.7	25.8	26.2	31.3	
Effective Green, g (s)	28.7	22.6	0.0	26.7	21.6	70.1	6.8	3.6	8.7	26.8	27.2	33.3	
Actuated g/C Ratio	0.41	0.32	0.00	0.38	0.31	1.00	0.10	0.05	0.12	0.38	0.39	0.48	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	283	1639	0	235	1567	1583	176	96	264	1312	723	820	
v/s Ratio Prot	0.03	c0.21		0.04	0.16		0.02	0.01	c0.08	c0.31	0.05	0.03	
v/s Ratio Perm	0.09			0.16		0.19	0.02		0.11			0.16	
v/c Ratio	0.29	0.65	0.00	0.51	0.53	0.19	0.38	0.28	1.08	0.80	0.14	0.28	
Uniform Delay, d1	13.3	20.4	35.0	15.2	20.0	0.0	29.7	32.0	30.7	19.3	13.9	11.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.6	2.0	0.0	1.9	1.3	0.3	1.3	1.6	79.4	3.7	0.1	0.2	
Delay (s)	13.9	22.4	35.0	17.1	21.3	0.3	31.0	33.6	110.1	23.0	14.0	11.3	
Level of Service	B	C	D	B	C	A	C	C	F	C	B	B	
Approach Delay (s)		22.9			15.9			91.5			20.0		
Approach LOS		C			B			F			C		

HCM Average Control Delay	26.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	70.1	Sum of lost time (s)	6.0
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX B:

DETAILED TRIP GENERATION AND PRODUCTIONS AND ATTRACTIONS (YEAR 2016 AND YEAR 2030)

Interim - Phases 1 - 5

Parcel #	Parcel Type	Units	Amount	LUC	Daily Rate	AM Rate	PM Rate	% In AM	% In PM	Trips				
										Weekday	AM In	AM Out	PM In	PM Out
A1	Shopping Center	TGSF	392.85	820	42.94	1.03	3.75	61%	48%	16,869	247	158	707	766
A2	Apartment	Dus	424	220	6.72	0.51	0.62	20%	65%	2,849	43	173	171	92
A3	Single Family	Dus	185	210	9.57	0.75	1.01	25%	63%	1,770	35	104	118	69
A4	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A5	Single Family	Dus	107	210	9.57	0.75	1.01	25%	63%	1,024	20	60	68	40
A6	Single Family	Dus	73	210	9.57	0.75	1.01	25%	63%	699	14	41	46	27
A7	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A8	Single Family	Dus	90	210	9.57	0.75	1.01	25%	63%	861	17	51	57	34
A9	Park	Acres	36	412	2.28	0.01	0.06	80%	41%	82	0	0	1	1
A10	Single Family	Dus	80	210	9.57	0.75	1.01	25%	63%	766	15	45	51	30
A11	Single Family	Dus	91	210	9.57	0.75	1.01	25%	63%	871	17	51	58	34
A12	Single Family	Dus	135	210	9.57	0.75	1.01	25%	63%	1,292	25	76	86	50
A13	Single Family	Dus	47	210	9.57	0.75	1.01	25%	63%	450	9	26	30	18
A14	Single Family	Dus	78	210	9.57	0.75	1.01	25%	63%	746	15	44	50	29
A15	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A16	Single Family	Dus	77	210	9.57	0.75	1.01	25%	63%	737	14	43	49	29
A17	Single Family	Dus	62	210	9.57	0.75	1.01	25%	63%	593	12	35	39	23
A18	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A19	Single Family	Dus	60	210	9.57	0.75	1.01	25%	63%	574	11	34	38	22
A20	Single Family	Dus	76	210	9.57	0.75	1.01	25%	63%	727	14	43	48	28
A21	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A22	Single Family	Dus	146	210	9.57	0.75	1.01	25%	63%	1,397	27	82	93	55
A23	Single Family	Dus	78	210	9.57	0.75	1.01	25%	63%	746	15	44	50	29
A24	Single Family	Dus	87	210	9.57	0.75	1.01	25%	63%	833	16	49	55	33
A25	Single Family	Dus	50	210	9.57	0.75	1.01	25%	63%	479	9	28	32	19
A26	Single Family	Dus	49	210	9.57	0.75	1.01	25%	63%	469	9	28	31	18
A27	Single Family	Dus	70	210	9.57	0.75	1.01	25%	63%	670	13	39	45	26
A28	Single Family	Dus	101	210	9.57	0.75	1.01	25%	63%	967	19	57	64	38
A29	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A30	Single Family	Dus	97	210	9.57	0.75	1.01	25%	63%	928	18	55	62	36
A31	Single Family	Dus	90	210	9.57	0.75	1.01	25%	63%	861	17	51	57	34
A32	Elementary School	Students	1000	520	1.29	0.42	0.28	55%	45%	1,290	231	189	126	154
A33	Single Family	Dus	132	210	9.57	0.75	1.01	25%	63%	1,263	25	74	84	49
A34	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A35	Single Family	Dus	105	210	9.57	0.75	1.01	25%	63%	1,005	20	59	67	39
A36	Single Family	Dus	153	210	9.57	0.75	1.01	25%	63%	1,464	29	86	97	57
A37	Shopping Center	TGSF	152.775	820	42.94	1.03	3.75	61%	48%	6,560	96	61	275	298
B1	Office Park	TGSF	0	750	11.42	1.74	1.50	89%	14%	0	0	0	0	0
B2	Office Park	TGSF	0	750	11.42	1.74	1.50	89%	14%	0	0	0	0	0
B3	Public Use (Fire Station)	Acres	0	---	---	---	---	---	---	---	---	---	---	---
B4	Shopping Center	TGSF	0	820	42.94	1.03	3.75	61%	48%	0	0	0	0	0
B5	Apartment	Dus	466	220	6.72	0.51	0.62	20%	65%	3,132	48	190	188	101
B6	Park	Acres	3	412	2.28	0.01	0.06	80%	41%	7	0	0	0	0
B7	Elementary School	Students	1000	520	1.29	0.42	0.28	55%	45%	1,290	231	189	126	154
B8	Single Family	Dus	140	210	9.57	0.75	1.01	25%	63%	1,340	26	79	89	52
B9	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B10	Single Family	Dus	187	210	9.57	0.75	1.01	25%	63%	1,790	35	105	119	70
B11	Apartment	Dus	422	220	6.72	0.51	0.62	20%	65%	2,836	43	172	170	92
B12	Apartment	Dus	358	220	6.72	0.51	0.62	20%	65%	2,406	37	146	144	78
B13	Single Family	Dus	123	210	9.57	0.75	1.01	25%	63%	1,177	23	69	78	46
B14	Single Family	Dus	99	210	9.57	0.75	1.01	25%	63%	947	19	56	63	37
B15	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B16	Single Family	Dus	127	210	9.57	0.75	1.01	25%	63%	1,215	24	71	81	47
B17	Single Family	Dus	138	210	9.57	0.75	1.01	25%	63%	1,321	26	78	88	52
B18	Single Family	Dus	149	210	9.57	0.75	1.01	25%	63%	1,426	28	84	95	56
B19	Townhouse	Dus	180	230	5.86	0.44	0.52	17%	67%	1,055	13	66	63	31
B20	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B21	Single Family	Dus	175	210	9.57	0.75	1.01	25%	63%	1,675	33	98	111	65
B22	Shopping Center	TGSF	207.3375	820	42.94	1.03	3.75	61%	48%	8,903	130	83	373	404
B23	Apartment	Dus	831	220	6.72	0.51	0.62	20%	65%	5,584	85	339	335	180
B24	Shopping Center	TGSF	87.3	820	42.94	1.03	3.75	61%	48%	3,749	55	35	157	170
B25	Shopping Center	TGSF	196.425	820	42.94	1.03	3.75	61%	48%	8,434	123	79	354	383
B26	Apartment	Dus	284	220	6.72	0.51	0.62	20%	65%	1,908	29	116	114	62
B27	Single Family	Dus	88	210	9.57	0.75	1.01	25%	63%	842	17	50	56	33
B28	Townhouse	Dus	262	230	5.86	0.44	0.52	17%	67%	1,535	20	96	91	45
B29	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B30	Single Family	Dus	155	210	9.57	0.75	1.01	25%	63%	1,483	29	87	99	58
B31	Elementary School	Students	1000	520	1.29	0.42	0.28	55%	45%	1,290	231	189	126	154
B32	Park	Acres	12	412	2.28	0.01	0.06	80%	41%	27	0	0	0	0
B33	Single Family	Dus	197	210	9.57	0.75	1.01	25%	63%	1,885	37	111	125	74
B34	Townhouse	Dus	142	230	5.86	0.44	0.52	17%	67%	832	11	52	49	24
B35	Townhouse	Dus	127	230	5.86	0.44	0.52	17%	67%	744	9	46	44	22
B36	Single Family	Dus	109	210	9.57	0.75	1.01	25%	63%	1,043	20	61	69	41
B37	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B38	Single Family	Dus	78	210	9.57	0.75	1.01	25%	63%	746	15	44	50	29
B39	Single Family	Dus	110	210	9.57	0.75	1.01	25%	63%	1,053	21	62	70	41
B40	Shopping Center	TGSF	54.5625	820	42.94	1.03	3.75	61%	48%	2,343	34	22	98	106
	Sum of DUs		7,690					Sum of Trips		113,918	2,503	4,761	6,383	4,886

Full Buildout - All Phases

Parcel #	Parcel Type	Units	Amount	LUC	Daily Rate	AM Rate	PM Rate	% In AM	% In PM	Trips				
										Weekday	AM In	AM Out	PM In	PM Out
A1	Shopping Center	TGSF	392.85	820	42.94	1.03	3.75	61%	48%	16,869	247	158	707	766
A2	Apartment	Dus	424	220	6.72	0.51	0.62	20%	65%	2,849	43	173	171	92
A3	Single Family	Dus	185	210	9.57	0.75	1.01	25%	63%	1,770	35	104	118	69
A4	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A5	Single Family	Dus	107	210	9.57	0.75	1.01	25%	63%	1,024	20	60	68	40
A6	Single Family	Dus	73	210	9.57	0.75	1.01	25%	63%	699	14	41	46	27
A7	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A8	Single Family	Dus	90	210	9.57	0.75	1.01	25%	63%	861	17	51	57	34
A9	Park	Acres	36	412	2.28	0.01	0.06	80%	41%	82	0	0	1	1
A10	Single Family	Dus	80	210	9.57	0.75	1.01	25%	63%	766	15	45	51	30
A11	Single Family	Dus	91	210	9.57	0.75	1.01	25%	63%	871	17	51	58	34
A12	Single Family	Dus	135	210	9.57	0.75	1.01	25%	63%	1,292	25	76	86	50
A13	Single Family	Dus	47	210	9.57	0.75	1.01	25%	63%	450	9	26	30	18
A14	Single Family	Dus	78	210	9.57	0.75	1.01	25%	63%	746	15	44	50	29
A15	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A16	Single Family	Dus	77	210	9.57	0.75	1.01	25%	63%	737	14	43	49	29
A17	Single Family	Dus	62	210	9.57	0.75	1.01	25%	63%	593	12	35	39	23
A18	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A19	Single Family	Dus	60	210	9.57	0.75	1.01	25%	63%	574	11	34	38	22
A20	Single Family	Dus	76	210	9.57	0.75	1.01	25%	63%	727	14	43	48	28
A21	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A22	Single Family	Dus	146	210	9.57	0.75	1.01	25%	63%	1,397	27	82	93	55
A23	Single Family	Dus	78	210	9.57	0.75	1.01	25%	63%	746	15	44	50	29
A24	Single Family	Dus	87	210	9.57	0.75	1.01	25%	63%	833	16	49	55	33
A25	Single Family	Dus	50	210	9.57	0.75	1.01	25%	63%	479	9	28	32	19
A26	Single Family	Dus	49	210	9.57	0.75	1.01	25%	63%	469	9	28	31	18
A27	Single Family	Dus	70	210	9.57	0.75	1.01	25%	63%	670	13	39	45	26
A28	Single Family	Dus	101	210	9.57	0.75	1.01	25%	63%	967	19	57	64	38
A29	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A30	Single Family	Dus	97	210	9.57	0.75	1.01	25%	63%	928	18	55	62	36
A31	Single Family	Dus	90	210	9.57	0.75	1.01	25%	63%	861	17	51	57	34
A32	Elementary School	Students	1000	520	1.29	0.42	0.28	55%	45%	1,290	231	189	126	154
A33	Single Family	Dus	132	210	9.57	0.75	1.01	25%	63%	1,263	25	74	84	49
A34	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
A35	Single Family	Dus	105	210	9.57	0.75	1.01	25%	63%	1,005	20	59	67	39
A36	Single Family	Dus	153	210	9.57	0.75	1.01	25%	63%	1,464	29	86	97	57
A37	Shopping Center	TGSF	152.775	820	42.94	1.03	3.75	61%	48%	6,560	96	61	275	298
B1	Office Park	TGSF	894.825	750	11.42	1.74	1.50	89%	14%	10,219	1,386	171	188	1,154
B2	Office Park	TGSF	731.1375	750	11.42	1.74	1.50	89%	14%	8,350	1,132	140	154	943
B3	Public Use (Fire Station)	Acres	2	---	---	---	---	---	---	---	---	---	---	---
B4	Shopping Center	TGSF	600.1875	820	42.94	1.03	3.75	61%	48%	25,772	377	241	1,080	1,170
B5	Apartment	Dus	466	220	6.72	0.51	0.62	20%	65%	3,132	48	190	188	101
B6	Park	Acres	3	412	2.28	0.01	0.06	80%	41%	7	0	0	0	0
B7	Elementary School	Students	1000	520	1.29	0.42	0.28	55%	45%	1,290	231	189	126	154
B8	Single Family	Dus	140	210	9.57	0.75	1.01	25%	63%	1,340	26	79	89	52
B9	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B10	Single Family	Dus	187	210	9.57	0.75	1.01	25%	63%	1,790	35	105	119	70
B11	Apartment	Dus	422	220	6.72	0.51	0.62	20%	65%	2,836	43	172	170	92
B12	Apartment	Dus	358	220	6.72	0.51	0.62	20%	65%	2,406	37	146	144	78
B13	Single Family	Dus	123	210	9.57	0.75	1.01	25%	63%	1,177	23	69	78	46
B14	Single Family	Dus	99	210	9.57	0.75	1.01	25%	63%	947	19	56	63	37
B15	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B16	Single Family	Dus	127	210	9.57	0.75	1.01	25%	63%	1,215	24	71	81	47
B17	Single Family	Dus	138	210	9.57	0.75	1.01	25%	63%	1,321	26	78	88	52
B18	Single Family	Dus	149	210	9.57	0.75	1.01	25%	63%	1,426	28	84	95	56
B19	Townhouse	Dus	180	230	5.86	0.44	0.52	17%	67%	1,055	13	66	63	31
B20	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B21	Single Family	Dus	175	210	9.57	0.75	1.01	25%	63%	1,675	33	98	111	65
B22	Shopping Center	TGSF	207.3375	820	42.94	1.03	3.75	61%	48%	8,903	130	83	373	404
B23	Apartment	Dus	831	220	6.72	0.51	0.62	20%	65%	5,584	85	339	335	180
B24	Shopping Center	TGSF	87.3	820	42.94	1.03	3.75	61%	48%	3,749	55	35	157	170
B25	Shopping Center	TGSF	196.425	820	42.94	1.03	3.75	61%	48%	8,434	123	79	354	383
B26	Apartment	Dus	284	220	6.72	0.51	0.62	20%	65%	1,908	29	116	114	62
B27	Single Family	Dus	88	210	9.57	0.75	1.01	25%	63%	842	17	50	56	33
B28	Townhouse	Dus	262	230	5.86	0.44	0.52	17%	67%	1,535	20	96	91	45
B29	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B30	Single Family	Dus	155	210	9.57	0.75	1.01	25%	63%	1,483	29	87	99	58
B31	Elementary School	Students	1000	520	1.29	0.42	0.28	55%	45%	1,290	231	189	126	154
B32	Park	Acres	12	412	2.28	0.01	0.06	80%	41%	27	0	0	0	0
B33	Single Family	Dus	197	210	9.57	0.75	1.01	25%	63%	1,885	37	111	125	74
B34	Townhouse	Dus	142	230	5.86	0.44	0.52	17%	67%	832	11	52	49	24
B35	Townhouse	Dus	127	230	5.86	0.44	0.52	17%	67%	744	9	46	44	22
B36	Single Family	Dus	109	210	9.57	0.75	1.01	25%	63%	1,043	20	61	69	41
B37	Park	Acres	2	412	2.28	0.01	0.06	80%	41%	5	0	0	0	0
B38	Single Family	Dus	78	210	9.57	0.75	1.01	25%	63%	746	15	44	50	29
B39	Single Family	Dus	110	210	9.57	0.75	1.01	25%	63%	1,053	21	62	70	41
B40	Shopping Center	TGSF	54.5625	820	42.94	1.03	3.75	61%	48%	2,343	34	22	98	106
	Sum of DUs		7,690					**Sum of Trips**		158,258	5,398	5,313	7,805	8,154

		%	Trip Productions					Trip Attractions				
Parcel #	Parcel Type	Attractions	Weekday	AM In	AM Out	PM In	PM Out	Weekday	AM In	AM Out	PM In	PM Out
A1	Shopping Center	30%	11,808	173	110	495	536	5,061	74	47	212	230
A2	Apartment	5%	2,707	41	164	162	87	142	2	9	9	5
A3	Single Family	5%	1,682	33	99	112	66	89	2	5	6	3
A4	Park	100%	0	0	0	0	0	5	0	0	0	0
A5	Single Family	5%	973	19	57	65	38	51	1	3	3	2
A6	Single Family	5%	664	13	39	44	26	35	1	2	2	1
A7	Park	100%	0	0	0	0	0	5	0	0	0	0
A8	Single Family	5%	818	16	48	54	32	43	1	3	3	2
A9	Park	100%	0	0	0	0	0	82	0	0	1	1
A10	Single Family	5%	727	14	43	48	28	38	1	2	3	1
A11	Single Family	5%	827	16	49	55	32	44	1	3	3	2
A12	Single Family	5%	1,227	24	72	82	48	65	1	4	4	3
A13	Single Family	5%	427	8	25	28	17	22	0	1	1	1
A14	Single Family	5%	709	14	42	47	28	37	1	2	2	1
A15	Park	100%	0	0	0	0	0	5	0	0	0	0
A16	Single Family	5%	700	14	41	47	27	37	1	2	2	1
A17	Single Family	5%	564	11	33	37	22	30	1	2	2	1
A18	Park	100%	0	0	0	0	0	5	0	0	0	0
A19	Single Family	5%	545	11	32	36	21	29	1	2	2	1
A20	Single Family	5%	691	14	41	46	27	36	1	2	2	1
A21	Park	100%	0	0	0	0	0	5	0	0	0	0
A22	Single Family	5%	1,327	26	78	88	52	70	1	4	5	3
A23	Single Family	5%	709	14	42	47	28	37	1	2	2	1
A24	Single Family	5%	791	15	46	53	31	42	1	2	3	2
A25	Single Family	5%	455	9	27	30	18	24	0	1	2	1
A26	Single Family	5%	445	9	26	30	17	23	0	1	2	1
A27	Single Family	5%	636	12	37	42	25	33	1	2	2	1
A28	Single Family	5%	918	18	54	61	36	48	1	3	3	2
A29	Park	100%	0	0	0	0	0	5	0	0	0	0
A30	Single Family	5%	882	17	52	59	34	46	1	3	3	2
A31	Single Family	5%	818	16	48	54	32	43	1	3	3	2
A32	Elementary School	85%	194	35	28	19	23	1,097	196	161	107	131
A33	Single Family	5%	1,200	24	71	80	47	63	1	4	4	2
A34	Park	100%	0	0	0	0	0	5	0	0	0	0
A35	Single Family	5%	955	19	56	63	37	50	1	3	3	2
A36	Single Family	5%	1,391	27	82	92	54	73	1	4	5	3
A37	Shopping Center	25%	4,920	72	46	206	223	1,640	24	15	69	74
B1	Office Park	25%	0	0	0	0	0	0	0	0	0	0
B2	Office Park	25%	0	0	0	0	0	0	0	0	0	0
B3	Public Use (Fire Sta	—	—	—	—	—	—	—	—	—	—	—
B4	Shopping Center	35%	0	0	0	0	0	0	0	0	0	0
B5	Apartment	5%	2,975	45	181	178	96	157	2	10	9	5
B6	Park	100%	0	0	0	0	0	7	0	0	0	0
B7	Elementary School	85%	194	35	28	19	23	1,097	196	161	107	131
B8	Single Family	5%	1,273	25	75	85	50	67	1	4	4	3
B9	Park	100%	0	0	0	0	0	5	0	0	0	0
B10	Single Family	5%	1,700	33	100	113	66	89	2	5	6	3
B11	Apartment	5%	2,694	41	164	162	87	142	2	9	9	5
B12	Apartment	5%	2,285	35	139	137	74	120	2	7	7	4
B13	Single Family	5%	1,118	22	66	74	44	59	1	3	4	2
B14	Single Family	5%	900	18	53	60	35	47	1	3	3	2
B15	Park	100%	0	0	0	0	0	5	0	0	0	0
B16	Single Family	5%	1,155	23	68	77	45	61	1	4	4	2
B17	Single Family	5%	1,255	25	74	83	49	66	1	4	4	3
B18	Single Family	5%	1,355	27	80	90	53	71	1	4	5	3
B19	Townhouse	5%	1,002	13	62	60	29	53	1	3	3	2
B20	Park	100%	0	0	0	0	0	5	0	0	0	0
B21	Single Family	5%	1,591	31	94	106	62	84	2	5	6	3
B22	Shopping Center	30%	6,232	91	58	261	283	2,671	39	25	112	121
B23	Apartment	5%	5,305	81	322	318	171	279	4	17	17	9
B24	Shopping Center	25%	2,811	41	26	118	128	937	14	9	39	43
B25	Shopping Center	25%	6,326	93	59	265	287	2,109	31	20	88	96
B26	Apartment	5%	1,813	28	110	109	59	95	1	6	6	3
B27	Single Family	5%	800	16	47	53	31	42	1	2	3	2
B28	Townhouse	5%	1,459	19	91	87	43	77	1	5	5	2
B29	Park	100%	0	0	0	0	0	5	0	0	0	0
B30	Single Family	5%	1,409	28	83	94	55	74	1	4	5	3
B31	Elementary School	85%	194	35	28	19	23	1,097	196	161	107	131
B32	Park	100%	0	0	0	0	0	27	0	0	0	0
B33	Single Family	5%	1,791	35	105	119	70	94	2	6	6	4
B34	Townhouse	5%	791	10	49	47	23	42	1	3	2	1
B35	Townhouse	5%	707	9	44	42	21	37	0	2	2	1
B36	Single Family	5%	991	19	58	66	39	52	1	3	3	2
B37	Park	100%	0	0	0	0	0	5	0	0	0	0
B38	Single Family	5%	709	14	42	47	28	37	1	2	2	1
B39	Single Family	5%	1,000	20	59	66	39	53	1	3	3	2
B40	Shopping Center	25%	1,757	26	16	74	80	586	9	5	25	27
			94,303	**1,667**	**3,969**	**5,313**	**3,786**	**19,615**	**836**	**791**	**1,070**	**1,101**

		%	Trip Productions					Trip Attractions				
Parcel #	Parcel Type	Attractions	Weekday	AM In	AM Out	PM In	PM Out	Weekday	AM In	AM Out	PM In	PM Out
A1	Shopping Center	30%	11,808	173	110	495	536	5,061	74	47	212	230
A2	Apartment	5%	2,707	41	164	162	87	142	2	9	9	5
A3	Single Family	5%	1,682	33	99	112	66	89	2	5	6	3
A4	Park	100%	0	0	0	0	0	5	0	0	0	0
A5	Single Family	5%	973	19	57	65	38	51	1	3	3	2
A6	Single Family	5%	664	13	39	44	26	35	1	2	2	1
A7	Park	100%	0	0	0	0	0	5	0	0	0	0
A8	Single Family	5%	818	16	48	54	32	43	1	3	3	2
A9	Park	100%	0	0	0	0	0	82	0	0	1	1
A10	Single Family	5%	727	14	43	48	28	38	1	2	3	1
A11	Single Family	5%	827	16	49	55	32	44	1	3	3	2
A12	Single Family	5%	1,227	24	72	82	48	65	1	4	4	3
A13	Single Family	5%	427	8	25	28	17	22	0	1	1	1
A14	Single Family	5%	709	14	42	47	28	37	1	2	2	1
A15	Park	100%	0	0	0	0	0	5	0	0	0	0
A16	Single Family	5%	700	14	41	47	27	37	1	2	2	1
A17	Single Family	5%	564	11	33	37	22	30	1	2	2	1
A18	Park	100%	0	0	0	0	0	5	0	0	0	0
A19	Single Family	5%	545	11	32	36	21	29	1	2	2	1
A20	Single Family	5%	691	14	41	46	27	36	1	2	2	1
A21	Park	100%	0	0	0	0	0	5	0	0	0	0
A22	Single Family	5%	1,327	26	78	88	52	70	1	4	5	3
A23	Single Family	5%	709	14	42	47	28	37	1	2	2	1
A24	Single Family	5%	791	15	46	53	31	42	1	2	3	2
A25	Single Family	5%	455	9	27	30	18	24	0	1	2	1
A26	Single Family	5%	445	9	26	30	17	23	0	1	2	1
A27	Single Family	5%	636	12	37	42	25	33	1	2	2	1
A28	Single Family	5%	918	18	54	61	36	48	1	3	3	2
A29	Park	100%	0	0	0	0	0	5	0	0	0	0
A30	Single Family	5%	882	17	52	59	34	46	1	3	3	2
A31	Single Family	5%	818	16	48	54	32	43	1	3	3	2
A32	Elementary School	85%	194	35	28	19	23	1,097	196	161	107	131
A33	Single Family	5%	1,200	24	71	80	47	63	1	4	4	2
A34	Park	100%	0	0	0	0	0	5	0	0	0	0
A35	Single Family	5%	955	19	56	63	37	50	1	3	3	2
A36	Single Family	5%	1,391	27	82	92	54	73	1	4	5	3
A37	Shopping Center	25%	4,920	72	46	206	223	1,640	24	15	69	74
B1	Office Park	25%	7,664	1,039	128	141	866	2,555	346	43	47	289
B2	Office Park	25%	6,262	849	105	115	707	2,087	283	35	38	236
B3	Public Use (Fire Sta	—	—	—	—	—	—	—	—	—	—	—
B4	Shopping Center	35%	16,752	245	157	702	761	9,020	132	84	378	410
B5	Apartment	5%	2,975	45	181	178	96	157	2	10	9	5
B6	Park	100%	0	0	0	0	0	7	0	0	0	0
B7	Elementary School	85%	194	35	28	19	23	1,097	196	161	107	131
B8	Single Family	5%	1,273	25	75	85	50	67	1	4	4	3
B9	Park	100%	0	0	0	0	0	5	0	0	0	0
B10	Single Family	5%	1,700	33	100	113	66	89	2	5	6	3
B11	Apartment	5%	2,694	41	164	162	87	142	2	9	9	5
B12	Apartment	5%	2,285	35	139	137	74	120	2	7	7	4
B13	Single Family	5%	1,118	22	66	74	44	59	1	3	4	2
B14	Single Family	5%	900	18	53	60	35	47	1	3	3	2
B15	Park	100%	0	0	0	0	0	5	0	0	0	0
B16	Single Family	5%	1,155	23	68	77	45	61	1	4	4	2
B17	Single Family	5%	1,255	25	74	83	49	66	1	4	4	3
B18	Single Family	5%	1,355	27	80	90	53	71	1	4	5	3
B19	Townhouse	5%	1,002	13	62	60	29	53	1	3	3	2
B20	Park	100%	0	0	0	0	0	5	0	0	0	0
B21	Single Family	5%	1,591	31	94	106	62	84	2	5	6	3
B22	Shopping Center	30%	6,232	91	58	261	283	2,671	39	25	112	121
B23	Apartment	5%	5,305	81	322	318	171	279	4	17	17	9
B24	Shopping Center	25%	2,811	41	26	118	128	937	14	9	39	43
B25	Shopping Center	25%	6,326	93	59	265	287	2,109	31	20	88	96
B26	Apartment	5%	1,813	28	110	109	59	95	1	6	6	3
B27	Single Family	5%	800	16	47	53	31	42	1	2	3	2
B28	Townhouse	5%	1,459	19	91	87	43	77	1	5	5	2
B29	Park	100%	0	0	0	0	0	5	0	0	0	0
B30	Single Family	5%	1,409	28	83	94	55	74	1	4	5	3
B31	Elementary School	85%	194	35	28	19	23	1,097	196	161	107	131
B32	Park	100%	0	0	0	0	0	27	0	0	0	0
B33	Single Family	5%	1,791	35	105	119	70	94	2	6	6	4
B34	Townhouse	5%	791	10	49	47	23	42	1	3	2	1
B35	Townhouse	5%	707	9	44	42	21	37	0	2	2	1
B36	Single Family	5%	991	19	58	66	39	52	1	3	3	2
B37	Park	100%	0	0	0	0	0	5	0	0	0	0
B38	Single Family	5%	709	14	42	47	28	37	1	2	2	1
B39	Single Family	5%	1,000	20	59	66	39	53	1	3	3	2
B40	Shopping Center	25%	1,757	26	16	74	80	586	9	5	25	27
			124,981	**3,800**	**4,359**	**6,271**	**6,120**	**33,277**	**1,598**	**954**	**1,534**	**2,035**

APPENDIX C:

ADOT SIGNAL WARRANT PROCEDURES

ENGINEERING DIVISION

TRAFFIC ENGINEERING BRANCH

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

Policy/Procedure Guideline

SECTION 4: Traffic Signals

SUBJECT 4.6: Evaluation of Future Traffic Signal Needs

EFFECTIVE DATE: April 30, 1997

PARAGRAPH:

1. Purpose
2. Description
3. Exhibits
4. Background
5. Authorization
6. References
7. Attachments

1. PURPOSE:

This PPG sets forth the procedure and criteria to be used in evaluating future traffic signal needs on projects in the Capital Improvement Project (CIP) program, or in any studies undertaken by or submitted to MCDOT.

2. DESCRIPTION:

ADT volume warrant. This warrant applies at a new intersection, an intersection revised by a proposed roadway construction project, or at the driveway of a new commercial or residential development, and is met when the following requirement is satisfied:

The estimated ADT on the major street and on the higher volume minor street or driveway approach to the intersection equals or exceeds the values in the following table:

Lanes for Moving Traffic on Each Approach		Estimated ADT	
Major Street	Minor Street	Major Street	Minor Street
1	1	10,000	3,000
2 or more	1	12,000	3,000
2 or more	2 or more	12,000	4,000
1	2 or more	10,000	4,000
1	1	15,000	1,500
2 or more	1	18,000	1,500
2 or more	2 or more	18,000	2,000
1	2 or more	15,000	2,000

* Based on the volumes projected to be present within 5 years of the completion of the roadway project, commercial development, or 5-year horizon for Category II, III, and IV developments as per MCDOT Traffic Impact Procedures.

3. **EXHIBITS:**

None.

4. **BACKGROUND:**

There is a need for uniform and consistent criteria to be applied in evaluating the need for future traffic signals on various types of projects done by MCDOT or submitted to MCDOT for review. Establishing such criteria will assist consultants, developers and MCDOT in the development and review of future traffic signal needs on these projects.

5. **AUTHORIZATION:**

By the direction of the Manager, Traffic Engineering Branch, Engineering Division, Maricopa County Department of Transportation.

6. **REFERENCES**

Manual on Uniform Traffic Control Devices (MUTCD), current MCDOT edition Traffic Impact Procedures, February, 1994.

7. ATTACHMENTS

None.

Approved: Donald F. Wiltshire

Donald F. Wiltshire, P.E
Manager, Traffic Engineering Branch

RECEIVED
OCT 04 2006
COMMUNITY DEVELOPMENT

Arizona Department of Transportation
Intermodal Transportation Division
206 South Seventeenth Avenue Phoenix, Arizona 85007-3213

Janet Napolitano
Governor

Victor M. Mendez
Director

Sam Elters
State Engineer

October 2, 2006

City of Surprise Planning Department
12425 West Bell Road Suite D100
Surprise, Arizona 85374
C/o Mr. David Neal

RE: **Sunhaven**/ PAD05-335/ Grand Ave.(US 60) & Dixileta Road

Dear Mr. Neal:

Thank you for your notification regarding the Rezone for the subject referenced above. ADOT has no comment on the proposed Rezone **at this time.**

However, this Plat seems to be real close to ADOT R/W (US 60). Please furnish copy of plat as soon as possible for review. ADOT does want to review and comment on the all development plans.

ADOT does reserve the right to review and comment any further development plans, changes and or additions for this site, as to any impact they may have on the State Highway System.

Should you have any questions, you may contact me at 602-712-8755or by fax at 602-712-3051, or in writing at 205 S. 17th Avenue, Right of Way Project Management Section, Suite 349 MD 612E, Phoenix, Arizona 85007. Thank you in advance for your cooperation.

Sincerely,

LOUIS J. MALLOQUE,
Right of Way Agent III
lmalloque@azdot.gov

Arizona Governor's Award for Quality
2001 Award Recipient

APPENDIX F:

CITY OF SURPRISE COMMENTS AND RESPONSE MEMO

TASK ENGINEERING
3707 North 7th Street • Suite 235 • Phoenix • AZ • 85014
Phone: 602 • 277 • 4224 Fax: 602 • 277 • 4228 e-mail: task@taskeng.net

December 21, 2005

MEMORANDUM

TO: Tracy Eberlein
City of Surprise

FROM: Ken Howell, P.E.

RE: Response to Comments on Sunhaven, Dove Valley and 203rd Avenue dated September 30, 2005

The following summarizes responses to each comment made by the City of Surprise on September 30, 2005. These responses will be incorporated into this revised traffic impact study. Each comment is listed verbatim followed by a summary of how the comment is addressed or is incorporated into the revised report.

1. *The City of Surprise has new cross-sections, including a new minimum ROW for Cul-de-sacs that allows for curb separated sidewalks.*

   The developer is proposing to use the City's current approved roadway cross sections as obtained from City staff on November 4th, 2005. The lone modification the Developer is proposing from these approved cross sections is with respect to the sidewalks shown on the Major Arterial and Parkway cross sections. Instead of providing a six foot concrete sidewalk on each side of the Major Arterial roadways, or six foot concrete sidewalk and six foot decomposed granite trail on each side of the Parkways as shown on the City's approved cross sections, the developer is proposing to provide an eight foot sidewalk on one side of the street in order to better accommodate bicycle traffic along with pedestrian traffic, and a five foot sidewalk on the opposite side of the street to accommodate pedestrian traffic for both the Major Arterial and Parkway cross sections. The Developer believes that this scenario will provide a more attractive, safe, and efficient manner for bicycle traffic to share sidewalk space with pedestrian traffic on the Major Arterials within the site. With respect to the Parkway adjacent to the site (Dove Valley Road), the developer anticipates that pedestrian and bicycle traffic will not be more than that seen on the Major Arterials within the site, and the developer is therefore proposing to use the same sidewalk standard for this Parkway as with the site's Major Arterials.

2. *Dove Valley Road and 187th Avenue are both planned parkways and will require 200' total ROW and have limited full access.*

Dove Valley Road is shown on the Surprise approved Transportation/Circulation Plan and will be shown as a 100 foot wide half-street right of way. One-Hundred Eighty-Seventh Avenue is also shown as a parkway north of Lone Mountain Road.

With respect to the Parkway designation for 187th Avenue, between Lone Mountain and the Dixeleta Drive alignment, we believe that the minor arterial designation as submitted is the appropriate classification. This belief is consistent with the designation of 187th Avenue to the south in the Asante development.

Additionally, with Lone Mountain Road operating as the point of connection to Grand Avenue, traffic on 187th Avenue will be distributed east and west on Lone Mountain Road, with smaller volumes on 187th Avenue to the south.

3. *Dixeleta Drive is planned as a four lane minor arterial all the way to Tillman Boulevard. Please show this and provide the half street.*

The realignment and extension of Lone Mountain Road through to Grand Avenue to connect with the existing railroad at-grade crossing and intersection, and Collector C/Collector B replace the function of the Dixeleta Road alignment.

The majority of the land south of the centerline of Dixeleta Drive is part of the Central Arizona Project property. It is anticipated to remain open space for the foreseeable future. This reduces the traffic that Dixeleta Drive might carry, and it makes it very difficult to secure the half of the road right of way south of the monument line. Collectors B and C serve future development on both sides and are therefore a more efficient alignment than Dixeleta Drive. Therefore it is recommended that Dixeleta Drive not be extended from 187th Avenue to Tillman Boulevard

4. *Please give us exhibits showing the site traffic alone, not just background and total.*

These will be included.

5. *Does the background traffic from the MAG model include the 21,000 homes proposed for the Chrysler Proving Grounds and the Whittman Ranch Development directly west of this site that is proposing an additional 1,500 lots? If it does, then the 50% reduction for you site traffic is not correct. If it does not, should these be included in the 2030 volumes?*

The adjustment to traffic volumes is necessary to avoid double counting site traffic that is included in the MAG projections. The two sites that are mentioned appear to have been considered employment zones in the MAG projections.

Our traffic study was prepared in advance of the City's decision on the Major GPA for the Proving Grounds. However, the analysis of the traffic in this area should be available in the traffic study submitted with the Proving Grounds GPA since Sunhaven was approved prior to its submittal to the City and therefore should have included the land uses, densities, and intensities approved by Maricopa County for the Sunhaven DMP and zoning approvals.

The Wittman Ranch GPA was withdrawn. There is no impact beyond the existing approved uses for this area.

6. *The City of Surprise requires signals to be placed at ½ mile increments (at a minimum). Please reconfigure your roadways to improve signal spacing.*

The land plan and collector street locations have been modified to achieve one-half mile spacing of traffic signals, with one minor exception on Lone Mountain Road. We believe, however, that the signal spacing at this point will comply with the intent of the standard.

7. *The City's right turn lane criteria is 40 vph for unsignalized intersections and 100 vph for signalized intersections.*

These criteria will be used to determine the need for right turn lanes in the revised report.

8. *Why aren't there any right turns onto Collector A from 203rd Avenue in year 2030?*

The new traffic assignment has turns at this location.

9. *Dove Valley Road is a planned parkway and will have limited access. The driveway on Collector D will have to be a right turn in, right turn out only at full build out.*

It is our understanding that Parkways will handle left turns by substituting a right turn and a downstream U-turn for the direct left turn. In this way left turns from Collector D will be accommodated in full build out. This will be noted in the revised report.

In order to analyze the more difficult maneuver, the interim condition with left turns at Dove Valley Road/Collector D is analyzed. In either case we believe that northbound to westbound and westbound to southbound movements will be accommodated by the ultimate design of Dove Valley Road/Collector D.

10. *5,000 vehicles per day is the maximum number of vehicles allowed on a two lane collector. Anything greater than 5,000 vpd requires a major collector at the minimum.*

We recommend that the decision on cross sections for collectors be made on the basis of peak hour level of service at major intersections, not on raw average daily traffic volumes. Using this criterion, the collector street cross sections as shown in the revised report provide acceptable levels of service (LOS "D" or better) at major intersections. Based upon this analysis, the minor collectors will function appropriately where shown.

Although Collector D (which is shown as a two lane collector in the original study) performs acceptably under the criteria described above, the Developer has decided to upgrade this to a 4 lane collector cross section. This collector ties Dove Valley Road (designated as a parkway) at the north to Lone Mountain Road (a major arterial) at the south, roughly at the one-half mile point between 203rd Avenue and 195th Avenue. Based on this functionality, the Developer is proposing to designate Collector D as a four-lane collector section, notwithstanding the fact that is performs acceptably under the Level of Service criteria explained above.

I hope this addresses the remaining issues regarding the traffic impact study for Sunhaven. If you have any questions, or if I can be of further help, please contact me at (602) 277-4224, or khowell@taskeng.net. Thank you.

H:\JobFiles\2322.01\2322.01C\Response to Comments 9-05.doc

CITY OF SURPRISE TRAFFIC ENGINEERING DIVISION
REVIEW COMMENT SHEET

PROJECT – Sunhaven	**DATE: 9/30/05**
Location: Dove Valley Road and 203rd Avenue	**REVIEWER:** Tracy Eberlein, tracy.eberlein@surpriseaz.com
Review: #1	**CODE:** A = WILL COMPLY B = DELETED C = CONSULTANT TO EVALUATE

ITEM NUMBER	DWG/SHT PAGE	COMMENT	FINAL DISPOSITION
1	Gen.	The City of Surprise has new cross-sections, including a new minimum ROW for Cul-de-sacs that allows for curb separated sidewalks.	C
2	Gen.	Dove Valley Road and 187th Avenue are both planned parkways and will require 200' total ROW and have limited full access.	A - C
3	Gen.	Dixeleta Drive is planned as a four lane minor arterial all the way to Tillman Boulevard. Please show this and provide the half street.	C
4	Gen.	Please give us exhibits showing the site traffic alone, not just background and total.	A
5	Gen.	Does the background traffic from the MAG model include the 21,000 homes proposed for the Chrysler Proving Gronds and the Whittman Ranch development directly west of this site that is proposing an additional 1500 lots? If it does, then the 50% reduction for your site traffic is not correct. If it does not, should these be included in your 2030 volumes?	C
6	Gen.	The City of Surprise requires signals to be placed at ½ mile increments (at a minimum). Please reconfigure your roadways to improve signal spacing.	A - C
7	Gen.	The City's right turn lane criteria is 40 vph for unsignalized intersections and 100 vph for signalized intersections. Following this criteria, in 2016 the following additional intersections need right turn deceleration lanes: Dove Valley Road and 203rd Ave. Dove Valley Road and Collector D Dove Valley Road and 187th Ave. Collector A and Collector E Collector A and Collector D Collector B and Collector C Lone Mountain Road and Collector B Tillman Road and Lone Mountain Road (SE bound) Tillman Road and Collector E (NE bound) Lone Mountain Road and Collector D (W bound) Include any that I may have missed.	C
8	21	Why aren't there any right turns onto Collector A from 203rd Avenue in year 2030.	A
9	Gen.	Dove Valley Road is a planned parkway and will have limited access. The driveway on Collector D will have to be a right turn in, right turn out only at full build out.	C
10	Gen.	5,000 vehicles per day is the maximum number of vehicles allowed on a two lane collector. Anything greater than 5,000 vpd requires a major collector at the minimum.	C

Concept Master Drainage Report
For
Sunhaven
Surprise, Arizona

Prepared for

Sunhaven I, LLC
c/o Mike Jesberger
426 North 44th Street, Suite 240
Phoenix, AZ 85008

602-286-0000

Prepared By

DEI Professional Services
6225 N. 24th Street, Suite 200
Phoenix, Arizona 85016
(602) 954-0038

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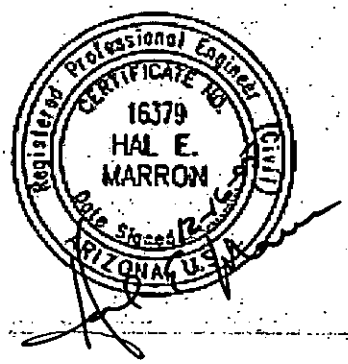
COMMUNITY DEVELOPMENT



July 14, 2005
REVISED: December 15, 2005

Concept Master Drainage Report
for
Sunhaven

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Figure 2 Flood Insurance Rate Map
Figure 3 Wittmann ADMS Sub-Area Boundary map

APPENDICES

Appendix A Box Culvert Calculations
Appendix B Excerpts from other Reports

EXHIBITS

EXHIBIT A Drainage Exhibit

1. INTRODUCTION

1.1 Scope

DEI Professional Services, LLC (DEI) has been contracted by Sunhaven I, LLC to provide engineering services in support of master planning for a proposed residential development (the site). The purpose of this report is to analyze stormwater and drainage requirements. In addition, this report is to present the proposed master drainage system that sets forth the drainage pattern and constraints that are to be used throughout the development of the project.

This report is focused on providing practical design information, evaluation, and calculations for statistical flood events up to and including the 100-year, 6-hour frequency flood. The procedures used herein are derived from, and performed with, currently accepted engineering methodologies and practices. Additionally, the criteria for this evaluation are designed to conform to currently applicable ordinances, regulations and policies affected by the appropriate jurisdictional regulatory authorities for the referenced site including, but not limited to, the Flood Control District of Maricopa County (FCDMC) and the City of Surprise (COS).

The analysis presented herein focuses on evaluation of stormwater runoff resulting from a statistical evaluation of storm events of a particular duration and frequency up to and including a 100-year, 6-hour storm events. Storm events exceeding the 100-year event may cause or create the risk of greater flood impact than is addressed and presented in this assessment. However, the scope of this assessment does not include evaluation of stormwater runoff resulting from storm events exceeding the 100-year, 6-hour frequency event. DEI assumes no responsibility for actual flood damage, increased risks of flood damage, or increased construction or development cost resulting from or related to any such events, nor shall DEI be responsible for any changes in, or additions to, regulatory requirements which may result from, or be related to, any such events or changes in hydrologic or hydraulic conditions within the watershed.

1.2 Site Description

The Sunhaven site is currently undeveloped desert approximately one mile southeast of Wittmann, Arizona. Sunhaven comprises approximately 2,120 acres within unincorporated Maricopa County, see Figure 1 – Vicinity Map at the end of the report text. The site includes Sections 17, 20, 21 and the portion of Section 19 East of US Highway 60 (Grand Avenue) of Township 5 North, Range 2 West of Gila and Salt River Meridian, Maricopa County, Arizona. The site may further be described as bounded by Grand Avenue on the West and West Dove Valley Road to the North. The South boundary is bounded by the West Dixileta Drive alignment. The East boundary is bounded by the 187th Avenue alignment.

1.3 Proposed Development

The site will be a planned area development. The site will contain single family residential, multi-family residential, commercial, employment, public facilities, local streets, parks and schools. Local streets will provide access to the site from the major arterials, 203rd Avenue and Grand Avenue. Minimum longitudinal street slopes will be 0.3-%. See **Appendix B** for typical roadway cross sections. The site includes areas of jurisdictional waters of the U.S. as determined by the U.S. Army Corps of Engineers. The developer has set aside riparian corridors of non-disturbance to exclude most designated washes from being developed. Developed condition washes will be engineered to contain the 100-year event storm within its banks with appropriate freeboard.

1.4 Project Phasing

The Sunhaven development will be developed in multiple phases. The first portion of the project that will be phased for development consists of an area of approximately 877-acres. The remainder of the property will be developed as part of later phases. All-weather routes will be constructed with each phase of development. The specific limits and locations will be per plans reviewed and approved by COS.

1.5 Regulatory Jurisdiction

The site will soon be annexed into the City of Surprise in Maricopa County, Arizona. Therefore, the site will be designed to meet the drainage requirements established by the COS (2004) and the FCDMC (1995). Jurisdictional Waters of the U.S. are regulated by the Army Corps of Engineers.

2. HYDROLOGIC SETTING

2.1 Topography

The site location can be found on the United States Geological Survey 7.5 minute Quadrangle maps entitled HIEROGLYPHIC MOUNTAINS SW and WITTMANN. The elevations range from approximately 1550 feet to 1690 feet. Existing ground slopes generally from the northwest to southeast at approximately 0.90 percent.

2.2 Regional Hydrology

The regional topography slopes generally from the northwest to southeast. The regional hydrologic conditions impacting the proposed Sunhaven site have been modeled in the Wittmann Area Drainage Master Study Update (FCDMC, 2004). The regional drainage patterns in the vicinity of the site direct stormwater runoff generally to the southeast.

3. MANAGEMENT OF OFF-SITE RUNOFF

Evaluation of off-site drainage contributory watershed relies on the Wittmann Area Drainage Master Study hydrology (FCDMC, 2004) that identifies significant stormwater runoff impacting the site. See Appendix B for excerpts from the hydrology developed for the Wittmann ADMS update report. The increase in impervious surfaces, due to development, increases peak flow and volume of runoff from the site. The increases will be attenuated through designing for the retention of the runoff from the 100-year, 2-hour storm event coming from all the developed areas of the site.

The surrounding properties consist of undeveloped desert with the exception of the Chrysler Proving grounds to the north. Drainage flows coming from the north, as identified in the latest Wittmann ADMS hydrology, will be passed through the site in drainage corridors following the existing channels, as determined as part of the USACE jurisdictional determination of 404 wash locations. This flow will be conveyed to the south and returned to the historical flow path at the existing channel at the site boundary. Box culverts are sized to allow the off-site flow to pass unimpeded under the major arterial crossings. Preliminary calculations assume inlet control conditions. Further calculations, i.e.: downstream channel flow depths, will be modeled for the final design of each culvert. See Appendix A for preliminary box culvert calculations.

4. PROPOSED MASTER DRAINAGE CONCEPT

The drainage concept to be employed by the project is to collect off-site flows and route them through the project to their historic flow paths. One such historic pathway is the existing channel on the north side of the BNSF railroad embankment. Since this channel is located within the BNSF Right-of-Way, this channel will largely be untouched by this project. The areas identified as open spaces and parks will be utilized as both conveyance areas and/or retention areas. Roadway crossings and other drainage features will be analyzed for the impact of the 100-year, 6-hour storm. All flows routed through the site will be discharged at the south side of the project. The intersection at 203rd Avenue and Grand Avenue (I-60) will be widened. The BNSF railroad crossing will be widened. Preliminary plans have been submitted to BNSF for comment. The box culverts in 203rd Avenue will be lengthened to meet the widened roadway section. It is anticipated that the development of this project will not impact the major drainage structures that cross under the BNSF railroad and Grand Avenue.

5. MANAGEMENT OF ON-SITE RUNOFF

On-site hydrology will be provided in the design report at the time the final grading plans are prepared. The on-site hydrology will be based on the rational method and in accordance with the FCDMC Drainage Design Manual, Volume I, Hydrology (1995. The drainage sub-basins will be delineated based on the final lot layout and the final grading plan. Times of concentration, runoff coefficients and the 10-year and 100-yr intensities will be based on FCDMC standards (1995). See Exhibit A for the proposed master drainage plan.

The on-site drainage scheme proposed for the project is to provide retention basins at various locations to contain the 100-yr, 2-hour storm event (p=2.80"). The site will be divided into several drainage areas based on the location of the retention basins and the drainage pattern of the streets and lots. The grading and retention basins will be designed such that any basin overflow will be conveyed by appropriate means to another basin or outfall point at a natural wash. Retention basins will be drained by means of dry wells, or bleeding off into an approved drainage way in accordance with current state and local drainage regulations. Bleed pipes in excess of 8-in. will include access barriers.

The streets within the development will be designed such that the 10-year flow is contained within the street curbs. The 50-year flow will be carried within the cross-section between buildings (front yards and streets). The finish floor elevation of all buildings will be one foot above the one-hundred-year storm. All finished floors will be a minimum of fourteen inches above the low outfall of the site. Street flow is generally from north to south and streets within the development will be designed to carry the flow to retention basins. If the capacity of the street is exceeded, a storm drain system will be provided such that the above requirements are met. Scuppers, catch basins and storm drains will be used to take the flow from the streets to the retention basins. The scuppers, catch basins and storm drains design will intercept flows in the street in excess of the 10-

basins and storm drains design will intercept flows in the street in excess of the 10-year storm water runoff in the street. Culverts will be used to convey on-site or off-site flows under the interior and arterial roads.

6. RETENTION

The City of Surprise requires retention for the 100-year, 2-hour event storm. A typical retention area will have a maximum design water depth of 3-feet with side slopes ranging between 4H:1V to 6H:1V, depending on adjacent properties and/or public areas. Retention areas will be landscaped areas in a theme that matches or is complimentary to the overall development. Flows generated on-site will be directed to retention basins distributed throughout the site. Some of these retention facilities are also identified as parks shown on **Exhibit A**. Other retention areas are not shown explicitly but will be included within the developed areas shown in Exhibit A, as appropriate. The retention volumes will be sized to meet the City of Surprise design standards. All retention areas will be designed to dissipate the required retention volume in 36-hours following cessation of the design storm event. Preliminary estimates for the total area required for retention total 311-acre-ft. See Tables 1 & 2 located on **Exhibit A** for preliminary calculations on the total required retention areas.

7. FLOOD ZONE INFORMATION

The Sunhaven site is located on Flood Insurance Rate Maps (FIRMs) number 04013C0694G, dated September 30, 2005 and 04013C0715G, dated September 30, 2005. The FIRMs indicate that Sunhaven is primarily located within a designated Zone X with isolated areas of Zone A (See Figure 2). There is one area designated a Zone A. The Zone A on the southwest corner of the site extends to Grand Avenue to the west of the site. Refer to Figure 2 for the FEMA map.

Most of the designated FEMA flood Zone A areas are located in the BNSF railroad Right-of-Way or 404 jurisdictional areas and will not be developed. Any areas to be developed that are shown to be in a Special Flood Hazard Zone A will require CLOMR-F application and a floodplain use permit from the floodplain administrator. All areas in designated flood zones to be developed will be treated on a case by case basis at the time of specific area development.

8. SUMMARY AND CONCLUSIONS

1. Off-site flows will be safely directed through or around the site.
2. On-site retention will be provided for the 100-year, 2-hour event in retention basins at various locations throughout the site. The retention basins will be designed to meet City of Surprise and FCDMC requirements.
3. The on-site 10-year flow will be conveyed within the street section between the curbs and the 100-year flow will be limited to 100-cfs in the street.
4. All finish floor evaluations are to be designed to be above the adjacent 100-year high water elevation in adjacent street and drain paths.
5. This site will be developed using generally accepted engineering practices and in accordance with the City of Surprise and FCDMC design standards.
6. BNSF railroad crossing into the development will require BNSF involvement including permits for work to widen the crossing at 203rd Avenue.
7. Developed areas located in designated FEMA floodplains will require CLOMR-F application and floodplain use permit.
8. All weather access will be maintained throughout the project. As each phase of development occurs, the plans will show how the access will be provided.

REFERENCES

1. Flood Control District of Maricopa County, *Wittmann ADMS Update, 2004 Hydrology, Maricopa County, Arizona*. 2004.

2. Federal Emergency Management Agency, Flood Insurance Rate Map (FIRM): Maricopa County, Arizona and Incorporated Areas, Panel 04013C0694G, September 30, 2005 and Panel 04013C0715G, September 30, 2005.

3. Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County, Volume I-Hydrology*, Revised January 1995.

4. City of Surprise, Arizona, *Preliminary and Final Drainage Report Guideline*, December 2004.

SUNHAVEN RANCH - VICINTTY MAP
CONCEPT DRAINAGE MASTER PLAN

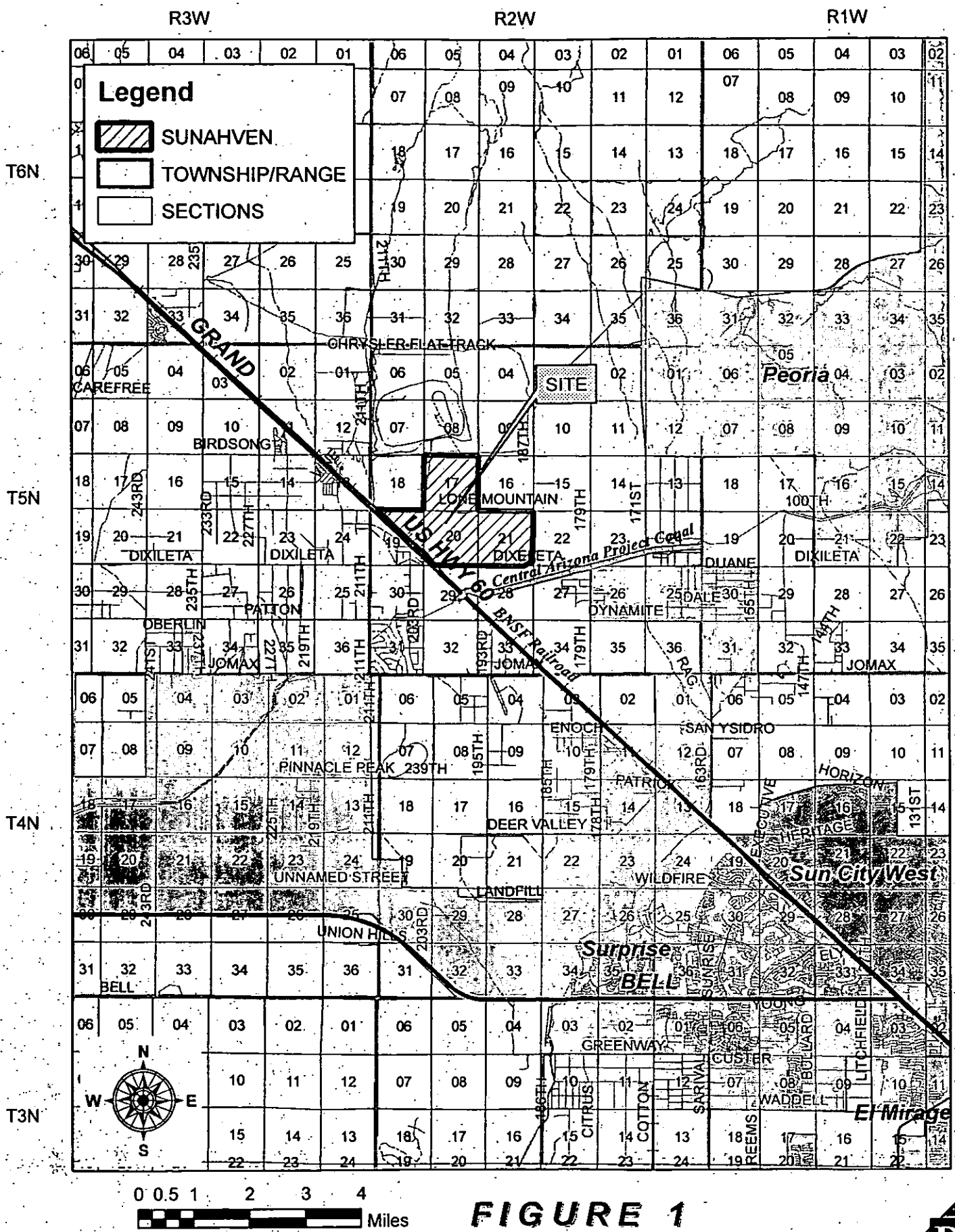
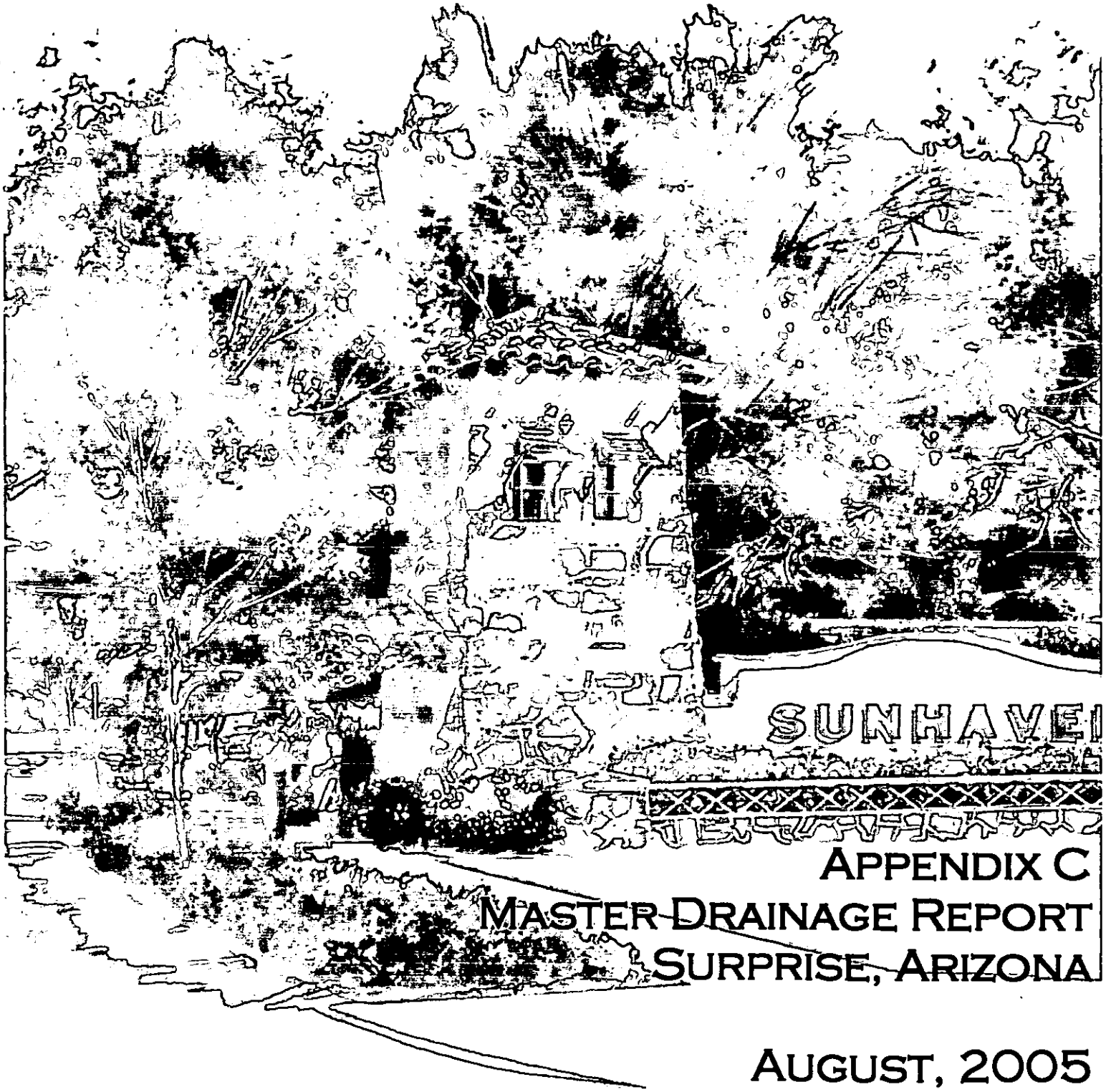


FIGURE 1

DEI Professional Services LLC

SUNHAVEN - PAD

A MASTER PLANNED COMMUNITY

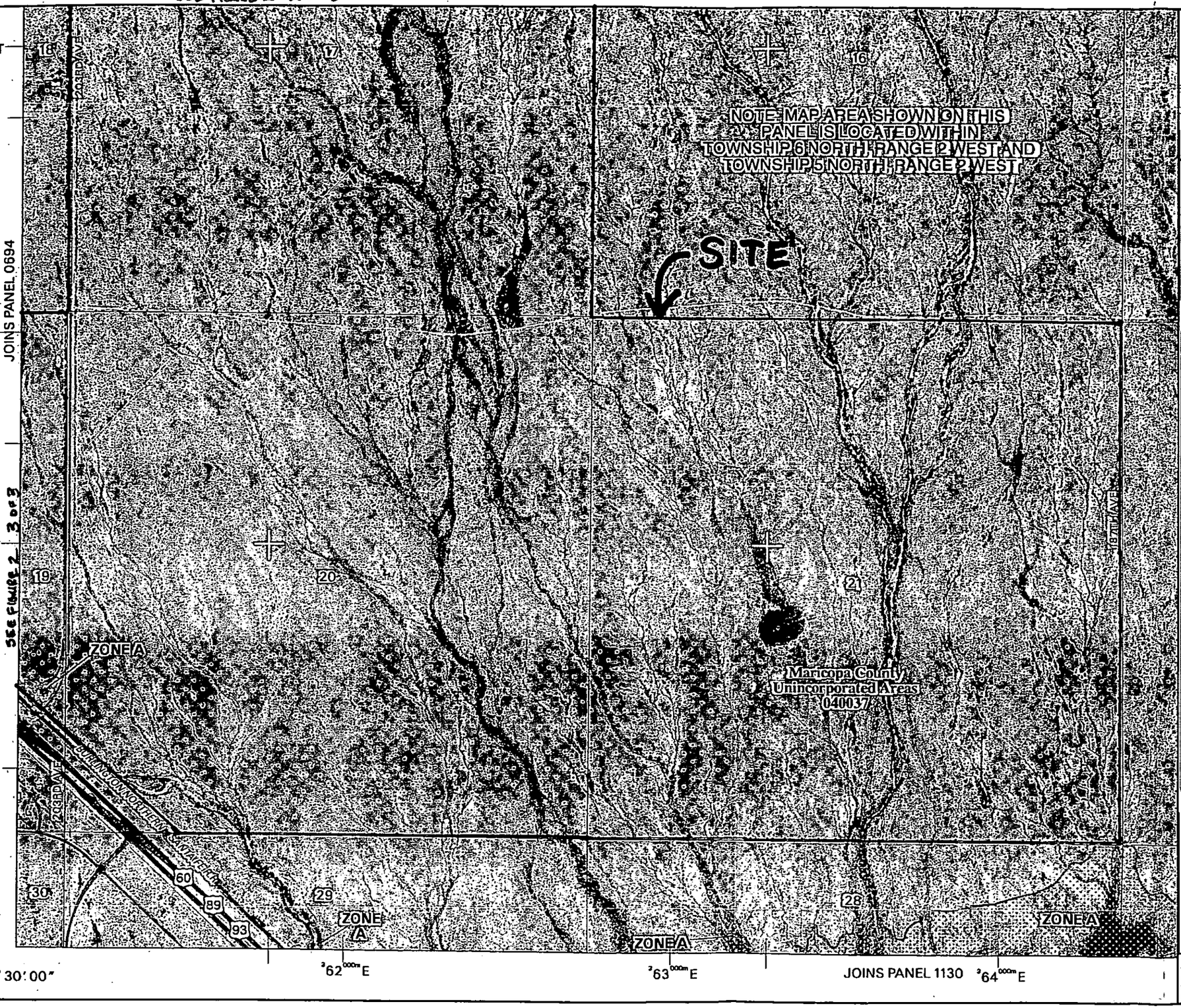


APPENDIX C
MASTER DRAINAGE REPORT
SURPRISE, ARIZONA

AUGUST, 2005

REVISED SUBMITTAL – DECEMBER, 2005

SEE FIGURE 2 2 OF 3



MAP SCALE 1" = 1000'

0 1000 2000 FEET

0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0715G

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 715 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	0715	G
SURPRISE, CITY OF	040053	0715	G

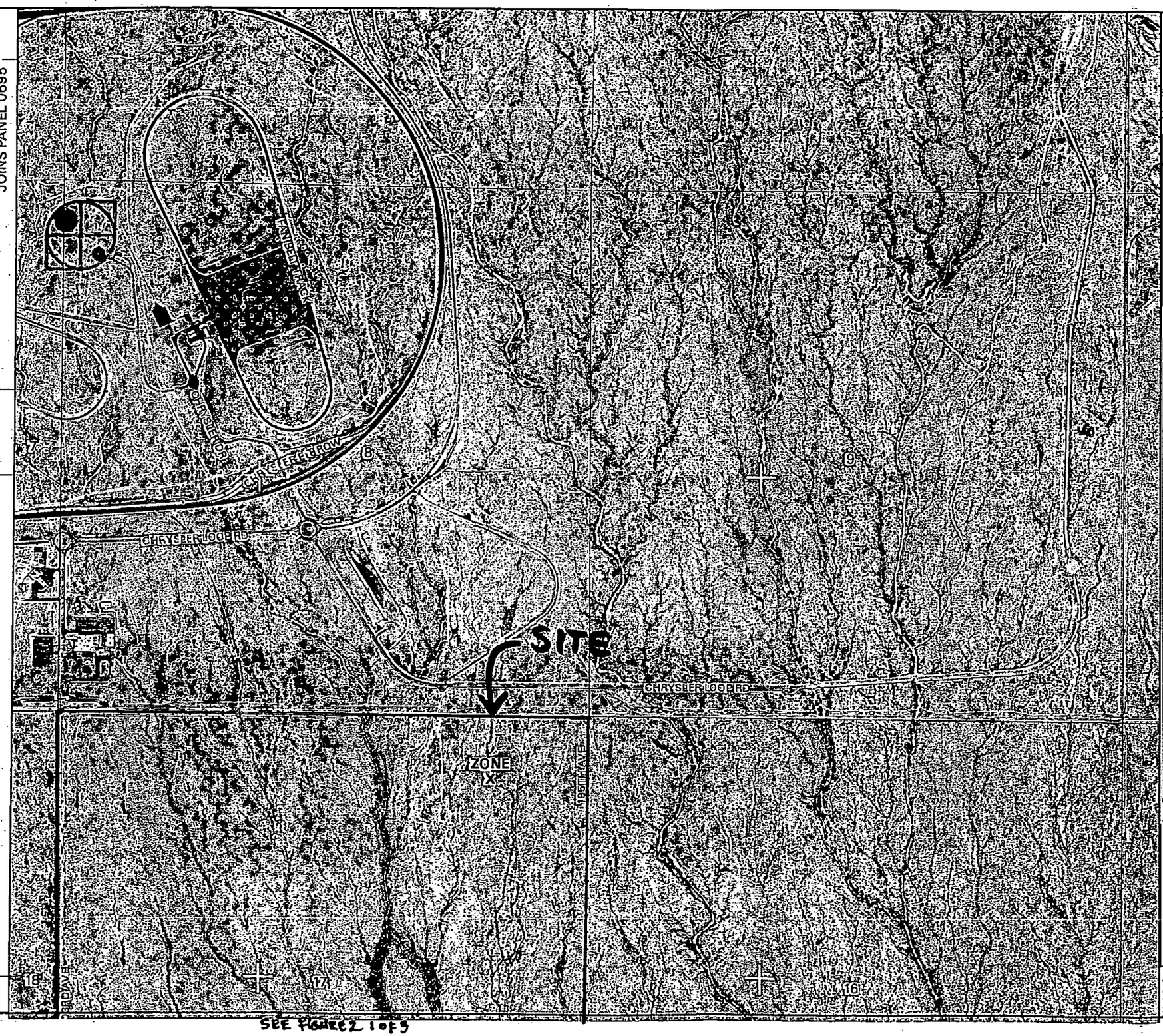
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C0715G
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

FIGURE 2
1 OF 3

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 1000'

0 1000 2000 FEET

0 300 600 METERS

NFIP

PANEL 0715G

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 715 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	0713	G
SURPRISE, CITY OF	040053	0715	G

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

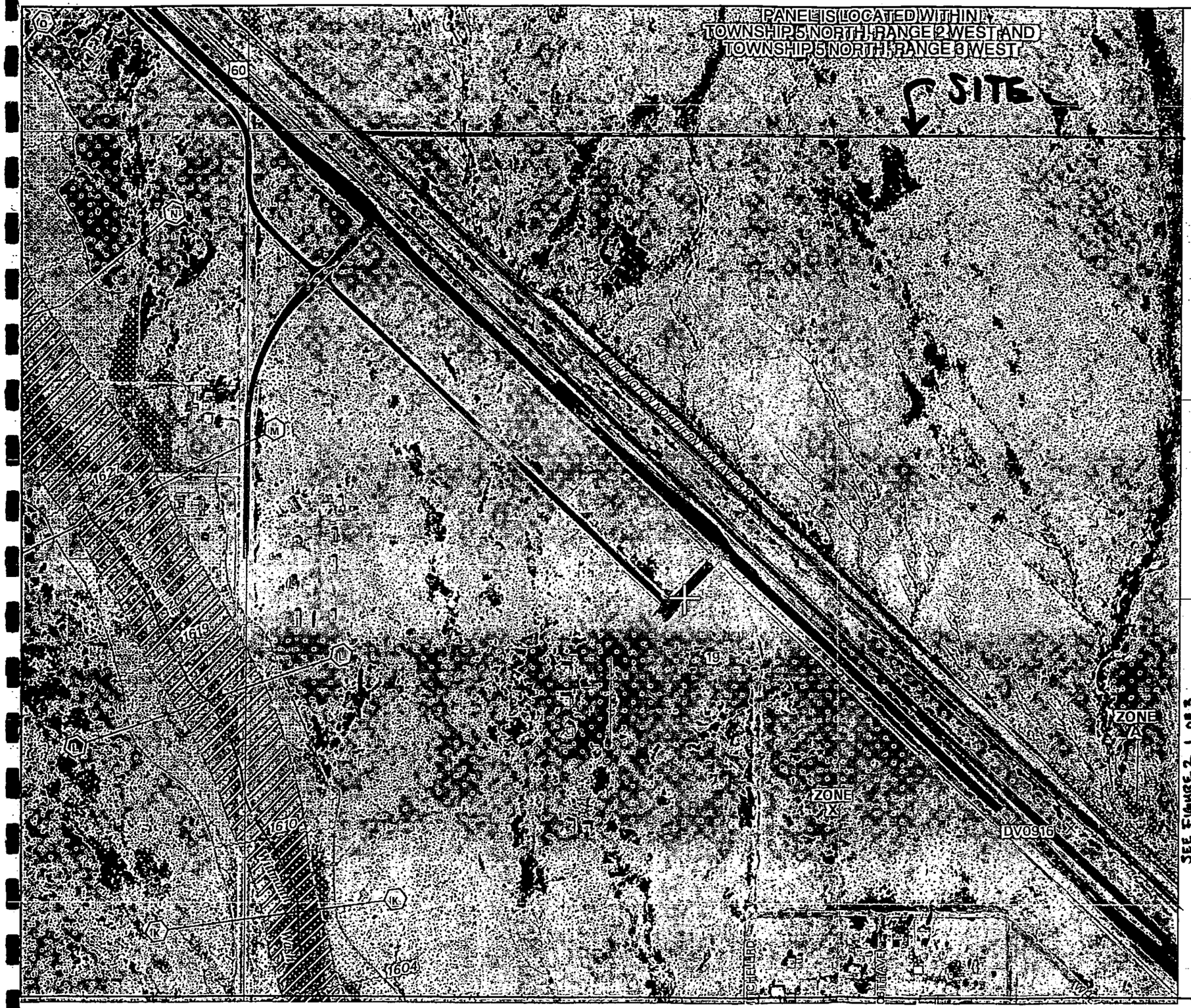
MAP NUMBER
04013C0715G
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

FIGURE 2
2 OF 3

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



JOINS PANEL 0715

37°37'000"N

MAP SCALE 1" = 500'

0 500 1000 FEET

0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0694G

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 694 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	0694	G

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER

04013C0694G

MAP REVISED

SEPTEMBER 30, 2005

Federal Emergency Management Agency

FIGURE 2
3 OF 3

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix A : BOX CULVERT CALCS

Culvert Calculator Report
BC-1

Comments: Q100 = CWI560

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	11.00 ft	Headwater Depth/Height	1.11
Computed Headwater Elevation	10.98 ft	Discharge	5,300.00 cfs
Inlet Control HW Elev.	10.82 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	10.98 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	5.47 ft
Slope Type	Steep	Normal Depth	4.89 ft
Flow Regime	Supercritical	Critical Depth	6.24 ft
Velocity Downstream	16.15 ft/s	Critical Slope	0.003460 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	12.00 ft
Section Size	12 x 9 ft	Rise	9.00 ft
Number Sections	5		

Outlet Control Properties			
Outlet Control HW Elev.	10.98 ft	Upstream Velocity Head	3.12 ft
Ke	0.20	Entrance Loss	0.62 ft

Inlet Control Properties			
Inlet Control HW Elev.	10.82 ft	Flow Control	N/A
Inlet Type	90° headwall w 45° bevels	Area Full	540.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
BC-2

Comments: Q100 = RWI556 + WI554

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	10.00 ft	Headwater Depth/Height	1.02
Computed Headwater Elevation	9.13 ft	Discharge	1,300.00 cfs
Inlet Control HW Elev.	9.01 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	9.13 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	4.44 ft
Slope Type	Steep	Normal Depth	4.07 ft
Flow Regime	Supercritical	Critical Depth	5.08 ft
Velocity Downstream	14.64 ft/s	Critical Slope	0.003649 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	10.00 ft
Section Size	10 x 8 ft	Rise	8.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	9.13 ft	Upstream Velocity Head	2.54 ft
Ke	0.20	Entrance Loss	0.51 ft

Inlet Control Properties			
Inlet Control HW Elev.	9.01 ft	Flow Control	N/A
Inlet Type	90° headwall w 45° bevels	Area Full	160.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
BC-3

Comments: Q100 = CWI542-RWI554

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	7.00 ft	Headwater Depth/Height	1.13
Computed Headwater Elevation	6.64 ft	Discharge	600.00 cfs
Inlet Control HW Elev.	6.55 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	6.64 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	3.04 ft
Slope Type	Steep	Normal Depth	2.86 ft
Flow Regime	Supercritical	Critical Depth	3.52 ft
Velocity Downstream	12.34 ft/s	Critical Slope	0.003757 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	8.00 ft
Section Size	8 x 5 ft	Rise	5.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	6.64 ft	Upstream Velocity Head	1.76 ft
Ke	0.20	Entrance Loss	0.35 ft

Inlet Control Properties			
Inlet Control HW Elev.	6.55 ft	Flow Control	Unsubmerged
Inlet Type	90° headwall w 45° bevels	Area Full	80.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
BC-4

Comments: Q100 = RWI544

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	10.00 ft	Headwater Depth/Height	1.07
Computed Headwater Elevation	9.54 ft	Discharge	700.00 cfs
Inlet Control HW Elev.	9.41 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	9.54 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	4.68 ft
Slope Type	Steep	Normal Depth	4.29 ft
Flow Regime	Supercritical	Critical Depth	5.34 ft
Velocity Downstream	14.94 ft/s	Critical Slope	0.003712 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	10.00 ft
Section Size	10 x 8 ft	Rise	8.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	9.54 ft	Upstream Velocity Head	2.67 ft
Ke	0.20	Entrance Loss	0.53 ft

Inlet Control Properties			
Inlet Control HW Elev.	9.41 ft	Flow Control	N/A
Inlet Type	90° headwall w 45° bevels	Area Full	80.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
BC-5

Comments: Q100 = RD544

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	10.00 ft	Headwater Depth/Height	1.09
Computed Headwater Elevation	9.75 ft	Discharge	1,450.00 cfs
Inlet Control HW Elev.	9.61 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	9.75 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	4.81 ft
Slope Type	Steep	Normal Depth	4.41 ft
Flow Regime	Supercritical	Critical Depth	5.47 ft
Velocity Downstream	15.09 ft/s	Critical Slope	0.003744 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	10.00 ft
Section Size	10 x 8 ft	Rise	8.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	9.75 ft	Upstream Velocity Head	2.73 ft
Ke	0.20	Entrance Loss	0.55 ft

Inlet Control Properties			
Inlet Control HW Elev.	9.61 ft	Flow Control	N/A
Inlet Type	90° headwall w 45° bevels	Area Full	160.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

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Culvert Calculator Report
BC-6

Comments: Q100 = RWI538

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	10.00 ft	Headwater Depth/Height	1.07
Computed Headwater Elevation	9.54 ft	Discharge	2,100.00 cfs
Inlet Control HW Elev.	9.41 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	9.54 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	4.68 ft
Slope Type	Steep	Normal Depth	4.29 ft
Flow Regime	Supercritical	Critical Depth	5.34 ft
Velocity Downstream	14.94 ft/s	Critical Slope	0.003712 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	10.00 ft
Section Size	10 x 8 ft	Rise	8.00 ft
Number Sections	3		

Outlet Control Properties			
Outlet Control HW Elev.	9.54 ft	Upstream Velocity Head	2.67 ft
Ke	0.20	Entrance Loss	0.53 ft

Inlet Control Properties			
Inlet Control HW Elev.	9.41 ft	Flow Control	N/A
Inlet Type	90° headwall w 45° bevels	Area Full	240.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
BC-7

Comments: Q100 = R530

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	10.00 ft	Headwater Depth/Height	0.92
Computed Headwater Elevation	9.27 ft	Discharge	1,600.00 cfs
Inlet Control HW Elev.	9.14 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	9.27 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	4.46 ft
Slope Type	Steep	Normal Depth	3.99 ft
Flow Regime	Supercritical	Critical Depth	5.17 ft
Velocity Downstream	14.94 ft/s	Critical Slope	0.003262 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	12.00 ft
Section Size	12 x 9 ft	Rise	9.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	9.27 ft	Upstream Velocity Head	2.58 ft
Ke	0.20	Entrance Loss	0.52 ft

Inlet Control Properties			
Inlet Control HW Elev.	9.14 ft	Flow Control	Unsubmerged
Inlet Type	90° headwall w 45° bevels	Area Full	216.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
BC-8

Comments: Q100 = WI552

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	7.00 ft	Headwater Depth/Height	1.44
Computed Headwater Elevation	6.77 ft	Discharge	500.00 cfs
Inlet Control HW Elev.	6.77 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	6.46 ft	Control Type	Inlet Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.97 ft
Slope Type	Steep	Normal Depth	2.84 ft
Flow Regime	Supercritical	Critical Depth	3.41 ft
Velocity Downstream	12.02 ft/s	Critical Slope	0.004052 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	6.46 ft	Upstream Velocity Head	1.70 ft
Ke	0.20	Entrance Loss	0.34 ft

Inlet Control Properties			
Inlet Control HW Elev.	6.77 ft	Flow Control	Submerged
Inlet Type	90° headwall w 45° bevels	Area Full	56.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
BC-9

Comments: Q100 = CWI544

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	7.00 ft	Headwater Depth/Height	0.61
Computed Headwater Elevation	6.53 ft	Discharge	2,187.00 cfs
Inlet Control HW Elev.	6.44 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	6.53 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.89 ft
Slope Type	Steep	Normal Depth	2.62 ft
Flow Regime	Supercritical	Critical Depth	3.46 ft
Velocity Downstream	12.61 ft/s	Critical Slope	0.002987 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	12.00 ft
Section Size	12 x 9 ft	Rise	9.00 ft
Number Sections	5		

Outlet Control Properties			
Outlet Control HW Elev.	6.53 ft	Upstream Velocity Head	1.73 ft
Ke	0.20	Entrance Loss	0.35 ft

Inlet Control Properties			
Inlet Control HW Elev.	6.44 ft	Flow Control	Unsubmerged
Inlet Type	90° headwall w 45° bevels	Area Full	540.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
BC-10

Comments: Q100 = CWI544 - RWI546

Solve For: Section Size

Culvert Summary			
Allowable HW Elevation	7.00 ft	Headwater Depth/Height	0.65
Computed Headwater Elevation	6.86 ft	Discharge	1,430.00 cfs
Inlet Control HW Elev.	6.76 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	6.86 ft	Control Type	Entrance Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.00 ft
Length	75.00 ft	Constructed Slope	0.006667 ft/ft

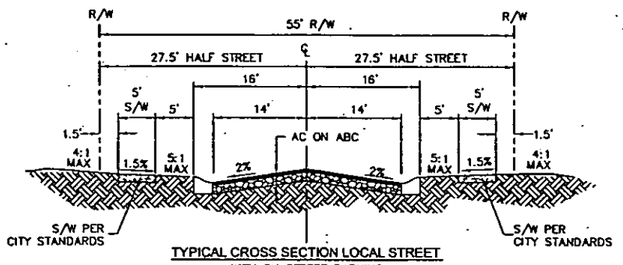
Hydraulic Profile			
Profile	S2	Depth, Downstream	3.08 ft
Slope Type	Steep	Normal Depth	2.78 ft
Flow Regime	Supercritical	Critical Depth	3.66 ft
Velocity Downstream	12.92 ft/s	Critical Slope	0.003015 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	12.00 ft
Section Size	12 x 9 ft	Rise	9.00 ft
Number Sections	3		

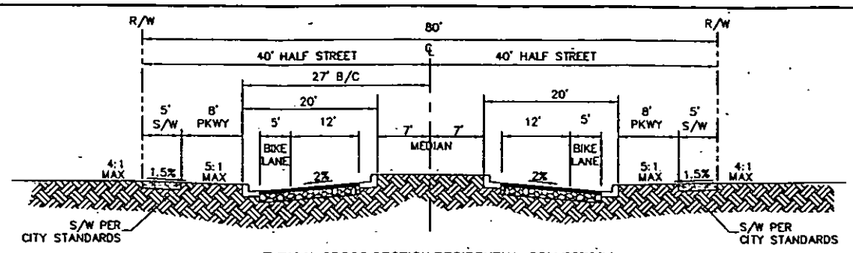
Outlet Control Properties			
Outlet Control HW Elev.	6.86 ft	Upstream Velocity Head	1.83 ft
Ke	0.20	Entrance Loss	0.37 ft

Inlet Control Properties			
Inlet Control HW Elev.	6.76 ft	Flow Control	Unsubmerged
Inlet Type	90° headwall w 45° bevels	Area Full	324.0 ft²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

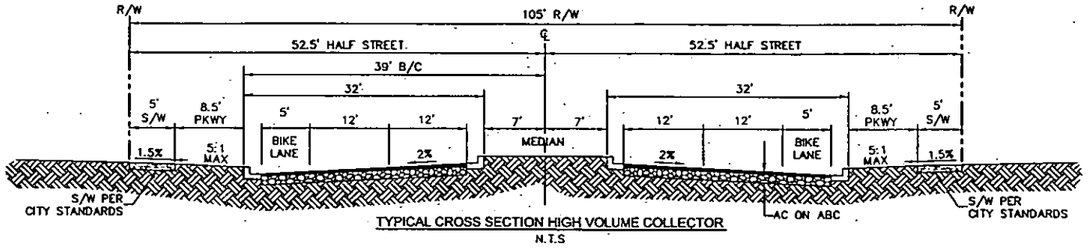
Appendix B : EXCERPTS FROM OTHER REPORTS



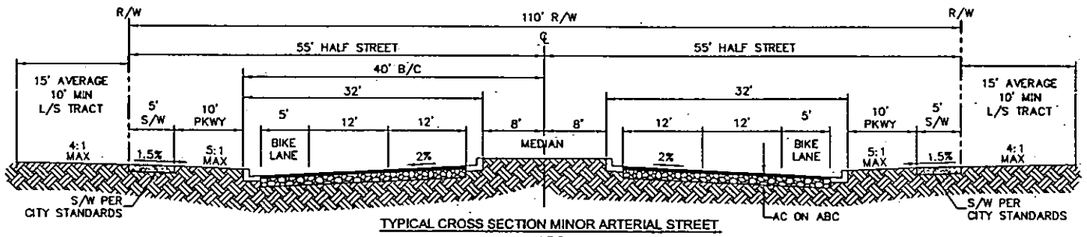
TYPICAL CROSS SECTION LOCAL STREET
WITH ON STREET PARKING
N.T.S



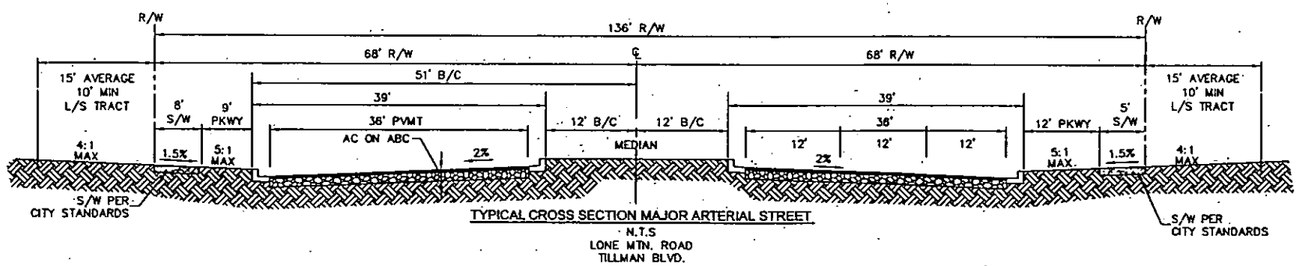
TYPICAL CROSS SECTION RESIDENTIAL COLLECTOR
MEDIAN AND BIKE LANE – NO PARKING
N.T.S



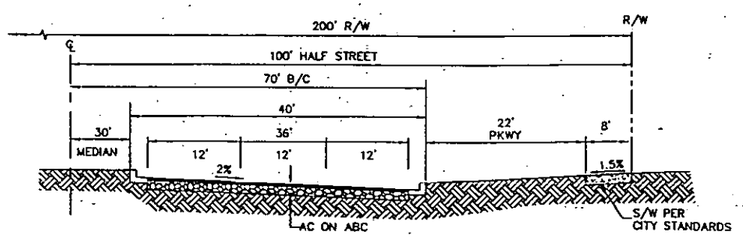
TYPICAL CROSS SECTION HIGH VOLUME COLLECTOR
N.T.S



TYPICAL CROSS SECTION MINOR ARTERIAL STREET
N.T.S



TYPICAL CROSS SECTION MAJOR ARTERIAL STREET
N.T.S
LONE MTN. ROAD
TILLMAN BLVD.



TYPICAL CROSS SECTION PARKWAY "HALF STREET"
N.T.S
DOVE VALLEY ROAD

Sunhaven

City of Surprise, Arizona

Planned Area Development
Figure 14
ROADWAY CROSS SECTIONS

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8605

Date: 05-12-05
Drawn By:
Revised: 7-12-05

NORTH
Not To Scale

LVA Urban Design Studio L.L.C.
Master Planned Communities, Land Planning, Site Planning & Design, Environmental Analysis & Landscape Design
7502 East Main Street
Scottsdale, Arizona 85251
Phone (480)994-0994
Fax (480)994-7332
www.lvadesign.com

FCDMC, Wittmann ADMS 2004 Hydrology

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE  22OCT04  TIME  14:43:03    *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
    1         ID  ********************************************************************************
    2         ID  ********************************************************************************
    3         ID  **                                                                            **
    4         ID  **   WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004          **
    5         ID  **                                                                            **
    6         ID  ********************************************************************************
    7         ID  ********************************************************************************
    8         ID
    9         ID  PROJECT:                Wittmann ADMS Update
   10         ID  CLIENT:                 Flood Control District of Maricopa County
   11         ID  PREPARED BY:            Entellus, Inc.
   12         ID  PROJECT No:             FCD 2002C029              Entellus 310.032
   13         ID  FILE NAME: WTFC6.hc1                    CREATED DATE: JUL 01, 2004
   14         ID                                         MODIFIED DATE: OCT 22, 2004
   15         ID
   16         ID  STORM:
   17         ID                          100-year 6-hour Storm
   18         ID
   19         ID  DEVELOPMENT CONDITIONS:
   20         ID                          Future Conditions
   21         ID
   22         ID  MODELING ASSUMPTIONS:
   23         ID                          It was assumed that the US60 did not have adequate
   24         ID                          storage to cause any significant attenuation.
   25         ID
   26         ID                          The assumption was made that the CAP Canal embankment
   27         ID                          would not be breached under a large flood event.
   28         ID
   29         ID                          The assumption was made that the Beardsley Canal would
   30         ID                          not fail under a large storm event (Per District
   31         ID                          Instruction).  In addition, the berm north of the
   32         ID                          Beardsley canal and east of US60 was assumed to fail
   33         ID                          (per district Instruction).
   34         ID
   35         ID                          For both the CAP and Beardsley Canals, once the berm
   36         ID                          elevation was reached weir flow was assumed.  It was
   37         ID                          also assumed that any weir flow over the canal that
   38         ID                          might enter the canal and be diverted out of the study
   39         ID                          area was insignificant, and thus was ignored.  In other
   40         ID                          words all weir flow over the canal embankment reaches
   41         ID                          the downstream concentration point.
   42         ID
   43         ID                          Typical X-sects were developed, and it was assumed
   44         ID                          that a typical x-sect could adequately represent
   45         ID                          various reaches.
   46         ID
   47         ID                          Time-Area Relations were used base on the District's
   48         ID                          Hydrology Manual criteria.  Two Time-Area Relation
   49         ID                          Curves were utilized:
   50         ID                                -Urban
   51         ID                                -Natural
   52         ID                          The Time-Area Relation Curves were taken directly
   53         ID                          from the manual
   54         ID
   55         ID  MODELING METHODS:
```

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  56          ID                      This model utilizes QI cards to input the Padelford
  57          ID                      hydrographs from an HEC-1 model developed for 100-yr
  58          ID                      6-hr Future conditions based on the 100-yr 24-hr HEC-1
  59          ID                      model by A-N West Inc. for the Padelford Wash
  60          ID                      Floodplain Delineation Study.  The hydrograph was
  61          ID                      altered from its original form (2 minute interval to
  62          ID                      5-minute interval) through simple interpolation.
  63          ID
  64          ID                      Clark Unit Hydrographs were used for all subbasins
  65          ID                      except the two subbasins directly upstream of the
  66          ID                      Bonita Dam (PD726B and PD740 use S-graphs).  The UC
  67          ID                      parameters were calculated using the HMS7.0 software.
  68          ID
  69          ID                      For Basins PD726B and PD740 S-Graphs were utilized per
  70          ID                      the request of the FCDMC.  Limited details regarding
  71          ID                      the calculations of the S-graphs can be found in the
  72          ID                      model by the basin KK card.  For full details of the
  73          ID                      S-graph calculations refer to the Appendix.
  74          ID
  75          ID                      Normal Depth routing was used for all routing reaches.
  76          ID
  77          ID                      Hard coding was used to account for the percentage of
  78          ID                      area associated with a diversion.  Because of the use
  79          ID                      of JD cards and aereal reduction, hard coding was
  80          ID                      necessary to properly account for area.  For a given
  81          ID                      diversion a percentage of the flow is routed to two
  82          ID                      different locations.  The same percentage of area
  83          ID                      follows that diverted flow.  In addition the area
  84          ID                      downstream of the main path is reduced or increased and
  85          ID                      is hard coded to account for the loss or gain of area.
  86          ID                      Hard coding was performed based on the 6-hour existing
  87          ID                      conditions model.
  88          ID
  89          ID                      Stage-storage was developed for all the structures
  90          ID                      along the CAP Canal, as well as along the Beardsley
  91          ID                      Canal.  In addition several stage-storage locations
  92          ID                      were developed for areas with significant storage
  93          ID                      along the SR74.  No storage was modeled along the US60
  94          ID                      and railroad, but the culverts were analyzed for
  95          ID                      diversion potential.  Diversions were placed in the
  96          ID                      model where deemed appropriate.  See appendix for
  97          ID                      details.
  98          ID
  99          ID                      FLO-2D was utilized to calculate the split flows at
 100          ID                      concentration points CIW351. CIW357, CIW363 and CWI576.
 101          ID                      See appendix for modeling details.
 102          ID
 103          ID   ********************************************************************************
 104          ID   ********************************************************************************
 105          ID
              *DIAGRAM
 106          IT       5                0    1500
 107          IO       5
 108          IN      15                0
 109          JD    3.40     0.01
              * 6-hour distribution
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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 110          PC   0.000   0.008   0.016   0.025   0.033   0.041   0.050   0.058   0.066   0.074
 111          PC   0.087   0.099   0.118   0.138   0.216   0.377   0.834   0.911   0.931   0.950
 112          PC   0.962   0.972   0.983   0.991   1.000
              *
 113          JD   3.378    0.50
 114          JD   3.314    2.80
 115          PC   0.000   0.009   0.016   0.025   0.034   0.042   0.051   0.059   0.067   0.076
 116          PC   0.087   0.100   0.120   0.163   0.252   0.451   0.694   0.837   0.900   0.938
 117          PC   0.950   0.963   0.975   0.988   1.000
              *
 118          JD   3.135   16.00
 119          PC   0.000   0.009   0.020   0.030   0.048   0.063   0.076   0.090   0.105   0.119
 120          PC   0.135   0.152   0.175   0.222   0.304   0.472   0.670   0.796   0.868   0.912
 121          PC   0.946   0.960   0.973   0.987   1.000
              *
 122          JD   2.761   90.00
 123          PC   0.000   0.021   0.035   0.051   0.071   0.087   0.105   0.125   0.143   0.160
 124          PC   0.179   0.201   0.232   0.281   0.364   0.500   0.658   0.773   0.841   0.888
 125          PC   0.927   0.945   0.964   0.982   1.000
              *
 126          JD   1.938  500.00
 127          PC   0.000   0.024   0.043   0.059   0.078   0.098   0.119   0.141   0.162   0.186
 128          PC   0.212   0.239   0.271   0.321   0.408   0.515   0.627   0.735   0.814   0.864
 129          PC   0.907   0.930   0.954   0.977   1.000
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              * ************* BEGINNING OF WEST PORTION OF DETAILED MODEL ****************** *
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* ****************** BEGINNING OF WHITE TANKS SUBAREA ***************************** *
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	WT140	2211.	5.17	705.	182.	61.	3.79		
ROUTED TO	RWT140	2148.	5.42	704.	182.	61.	3.79		
HYDROGRAPH AT	WT130	2054.	4.75	487.	123.	41.	2.57		
2 COMBINED AT	CWT130	3077.	5.25	1101.	285.	95.	6.36		
ROUTED TO	RWT130	2889.	5.75	1099.	285.	95.	6.36		
HYDROGRAPH AT	WT160	836.	4.58	175.	44.	15.	.81		
ROUTED TO	RWT160	550.	6.25	174.	44.	15.	.81		
HYDROGRAPH AT	WT150A	3021.	5.08	872.	223.	74.	4.75		
ROUTED TO	R150A	2922.	5.25	871.	223.	74.	4.75		
HYDROGRAPH AT	WT150	1230.	4.50	229.	58.	19.	1.09		
2 COMBINED AT	CWT150	3269.	5.17	1046.	269.	90.	5.84		
ROUTED TO	RWT150	3152.	5.58	1044.	269.	90.	5.84		
HYDROGRAPH AT	WT120	2002.	4.83	500.	126.	42.	2.80		
4 COMBINED AT	CWT120	6236.	5.58	2450.	636.	212.	15.81		
ROUTED TO	RWT120	6038.	6.17	2448.	636.	212.	15.81		
HYDROGRAPH AT	WT110	2494.	4.67	527.	133.	44.	2.90		
2 COMBINED AT	CWT110	6086.	6.08	2774.	724.	241.	18.71		
ROUTED TO	RWT110	5779.	6.83	2766.	724.	241.	18.71		
HYDROGRAPH AT	WT100	3019.	4.75	741.	188.	63.	3.85		
2 COMBINED AT	CWT100	5796.	6.75	3218.	855.	285.	22.55		
ROUTED TO	RWT100	5471.	7.08	3198.	855.	285.	22.55		
HYDROGRAPH AT	TW406	525.	4.08	37.	9.	3.	.16		
ROUTED TO	RTW406	41.	8.33	31.	9.	3.	.16		
HYDROGRAPH AT	TW408	604.	4.83	190.	49.	16.	.91		

+	ROUTED TO	RTW408	327.	7.58	165.	49.	16.	.91
+	HYDROGRAPH AT	TW404	2543.	4.25	449.	113.	38.	2.09
+	4 COMBINED AT	CTW404	5469.	7.17	3503.	970.	323.	25.72
+	ROUTED TO	RTW404	5371.	7.42	3472.	965.	322.	25.72
+	HYDROGRAPH AT	IW371	96.	4.08	10.	2.	1.	.05
+	DIVERSION TO	DO371	70.	4.08	5.	1.	0.	.05
+	HYDROGRAPH AT	D371	25.	4.08	4.	1.	0.	.05
+	ROUTED TO	RIW371	13.	6.58	4.	1.	0.	.05
+	HYDROGRAPH AT	IW366	992.	4.33	194.	49.	16.	1.06
+	2 COMBINED AT	CIW366	989.	4.33	196.	50.	17.	1.07
+	ROUTED TO	RIW366	869.	4.83	196.	50.	17.	1.07
+	HYDROGRAPH AT	IW377	153.	4.17	23.	6.	2.	.11
+	ROUTED TO	SSR010	122.	4.42	23.	6.	2.	.11
+	ROUTED TO	RIW377	100.	5.17	23.	6.	2.	.11
+	HYDROGRAPH AT	IW374	738.	4.17	96.	24.	8.	.39
+	HYDROGRAPH AT	D371	70.	4.08	5.	1.	0.	.05
+	ROUTED TO	RD371	36.	4.33	5.	1.	0.	.05
+	3 COMBINED AT	CIW374	757.	4.17	122.	31.	10.	.54
+	ROUTED TO	RIW374	395.	5.83	119.	31.	10.	.54
+	HYDROGRAPH AT	IW386	389.	4.58	88.	22.	7.	.37
+	ROUTED TO	RIW386	294.	5.42	87.	22.	7.	.37
+	HYDROGRAPH AT	IW382	762.	4.33	137.	34.	11.	.62
+	2 COMBINED AT	CIW382	708.	4.33	215.	55.	18.	.99
+	DIVERSION TO	DO382B	180.	3.92	113.	29.	10.	.99
+	HYDROGRAPH AT	D382B	528.	4.33	103.	26.	9.	.99
+	DIVERSION TO	DO382A	247.	4.33	22.	6.	2.	.99
+	HYDROGRAPH AT	D382A	281.	4.33	80.	20.	7.	.99
+	ROUTED TO	RIW382	258.	4.83	80.	20.	7.	.99
+	HYDROGRAPH AT	IW384	180.	4.08	21.	5.	2.	.08
+	HYDROGRAPH AT	D382A	247.	4.33	22.	6.	2.	.99
+	ROUTED TO	RD382A	217.	4.42	22.	6.	2.	.99
+	2 COMBINED AT	CIW384	394.	4.33	50.	13.	4.	.41

+	ROUTED TO RIW384	323.	4.67	50.	13.	4.	.41
+	HYDROGRAPH AT IW381	433.	4.33	98.	25.	8.	.38
+	HYDROGRAPH AT D382B	180.	3.92	113.	29.	10.	.99
+	2 COMBINED AT CIW381	599.	4.33	208.	54.	18.	.64
+	ROUTED TO RIW381	563.	4.67	207.	54.	18.	.64
+	3 COMBINED AT C359*	1004.	4.75	325.	83.	28.	1.45
+	ROUTED TO R359*	951.	5.08	322.	83.	28.	1.45
+	HYDROGRAPH AT IW359	2318.	4.50	524.	132.	44.	2.91
+	4 COMBINED AT CIW359	3009.	4.83	1023.	266.	89.	5.97
+	ROUTED TO RIW359	2865.	5.17	1011.	266.	89.	5.97
+	HYDROGRAPH AT IW389	158.	4.33	34.	8.	3.	.13
+	ROUTED TO SSR190	158.	4.33	34.	8.	3.	.13
+	ROUTED TO RIW389	99.	5.67	33.	8.	3.	.13
+	HYDROGRAPH AT IW394	2805.	5.08	819.	209.	70.	4.17
+	ROUTED TO RIW394	2722.	5.25	818.	209.	70.	4.17
+	HYDROGRAPH AT IW390A	753.	4.75	192.	49.	16.	.90
+	2 COMBINED AT C390A	3115.	5.25	969.	248.	83.	5.07
+	ROUTED TO R390A	3013.	5.42	968.	248.	83.	5.07
+	HYDROGRAPH AT IW390	197.	4.50	58.	15.	5.	.31
+	HYDROGRAPH AT IW392	1811.	4.17	241.	60.	20.	1.11
+	3 COMBINED AT CIW390	3091.	5.42	1196.	307.	102.	6.50
+	ROUTED TO SSR160	3068.	5.50	1196.	307.	102.	6.50
+	ROUTED TO RIW390	2958.	5.75	1187.	307.	102.	6.50
+	HYDROGRAPH AT IW388	1052.	4.58	305.	77.	26.	1.23
+	3 COMBINED AT CIW388	3396.	5.75	1464.	380.	127.	7.85
+	ROUTED TO RIW388	3305.	6.00	1457.	380.	127.	7.85
+	HYDROGRAPH AT IW357	843.	4.33	185.	46.	15.	.75
+	2 COMBINED AT CIW357	3404.	5.92	1595.	418.	139.	8.60
+	DIVERSION TO DO357	857.	5.92	415.	108.	36.	8.60
+	HYDROGRAPH AT D357	2547.	5.92	1180.	310.	103.	8.60
+	ROUTED TO RIW357	2465.	6.50	1167.	310.	103.	8.60
	HYDROGRAPH AT						

+		IW358	144.	4.33	33.	8.	3.	.16
+	HYDROGRAPH AT	IW353	2507.	4.58	665.	168.	56.	2.80
+	4 COMBINED AT	CIW353	5051.	5.33	2560.	691.	230.	15.28
+	ROUTED TO	RIW353	4906.	5.58	2538.	691.	230.	15.28
+	HYDROGRAPH AT	IW350	1438.	4.75	512.	132.	44.	2.17
+	2 COMBINED AT	CIW350	5645.	5.50	2902.	793.	264.	17.45
+	HYDROGRAPH AT	IW312	470.	4.58	149.	38.	13.	.57
+	DIVERSION TO	DO312	212.	4.58	31.	8.	3.	.57
+	HYDROGRAPH AT	D312	258.	4.58	118.	30.	10.	.57
+	ROUTED TO	RIW312	239.	5.58	116.	30.	10.	.57
+	HYDROGRAPH AT	IW363	1073.	4.25	163.	41.	14.	.63
+	HYDROGRAPH AT	IW365	376.	4.58	126.	32.	11.	.47
+	HYDROGRAPH AT	D312	212.	4.58	31.	8.	3.	.57
+	ROUTED TO	RD312	206.	4.67	31.	8.	3.	.57
+	2 COMBINED AT	CIW365	557.	4.67	155.	39.	13.	.74
+	DIVERSION TO	DO365	257.	4.67	33.	8.	3.	.74
+	HYDROGRAPH AT	D365	300.	4.67	122.	31.	10.	.74
+	ROUTED TO	RIW365	297.	5.17	121.	31.	10.	.74
+	HYDROGRAPH AT	IW367	107.	4.17	14.	4.	1.	.05
+	HYDROGRAPH AT	D365	257.	4.67	33.	8.	3.	.74
+	ROUTED TO	RD365	245.	4.83	33.	8.	3.	.74
+	2 COMBINED AT	CIW367	301.	4.75	50.	12.	4.	.43
+	HYDROGRAPH AT	IW369	565.	4.67	204.	52.	17.	.79
+	DIVERSION TO	DO369	350.	4.67	78.	20.	7.	.79
+	HYDROGRAPH AT	D369	216.	4.67	126.	33.	11.	.79
+	2 COMBINED AT	C363*	490.	4.75	172.	45.	15.	.72
+	ROUTED TO	RIW369	458.	5.17	171.	45.	15.	.72
+	HYDROGRAPH AT	D357	857.	5.92	415.	108.	36.	8.60
+	ROUTED TO	RD357	849.	6.08	414.	108.	36.	8.60
+	5 COMBINED AT	CIW363	1805.	5.08	979.	256.	85.	4.26
+	DIVERSION TO	DO363	572.	5.08	291.	76.	25.	4.26
+	HYDROGRAPH AT	D363	1234.	5.08	687.	180.	60.	4.26

+	ROUTED TO	RIW363	1211.	5.67	680.	180.	60.	4.26
+	HYDROGRAPH AT	IW368	263.	4.33	53.	13.	4.	.29
+	HYDROGRAPH AT	D369	350.	4.67	78.	20.	7.	.79
+	ROUTED TO	RD369	331.	4.92	78.	20.	7.	.79
+	2 COMBINED AT	CIW368	498.	4.75	129.	32.	11.	.79
+	ROUTED TO	RIW368	456.	5.33	129.	32.	11.	.79
+	HYDROGRAPH AT	IW360	900.	4.25	146.	37.	12.	.83
+	2 COMBINED AT	CIW360	775.	4.33	252.	64.	21.	1.62
+	ROUTED TO	RIW360	755.	4.42	252.	64.	21.	1.62
+	HYDROGRAPH AT	IW397	4160.	4.92	1193.	305.	102.	4.81
+	ROUTED TO	RIW397	3910.	5.42	1183.	305.	102.	4.81
+	HYDROGRAPH AT	IW395	6231.	5.00	1664.	422.	141.	7.86
+	2 COMBINED AT	CIW395	8463.	5.17	2670.	693.	231.	12.68
+	ROUTED TO	RIW395	8270.	5.42	2664.	693.	231.	12.68
+	HYDROGRAPH AT	IW387	1312.	4.67	254.	64.	21.	1.35
+	ROUTED TO	RIW387	1312.	4.67	254.	64.	21.	1.35
+	HYDROGRAPH AT	IW396	389.	4.75	108.	27.	9.	.59
+	3 COMBINED AT	CIW396	8699.	5.42	2895.	752.	251.	14.61
+	ROUTED TO	RIW396	8607.	5.50	2891.	752.	251.	14.61
+	HYDROGRAPH AT	IW380	643.	4.25	109.	27.	9.	.50
+	2 COMBINED AT	CIW380	8664.	5.50	2965.	771.	257.	15.11
+	ROUTED TO	SSR310	8651.	5.58	2965.	771.	257.	15.11
+	DIVERSION TO	DO380	2563.	5.58	389.	97.	32.	15.11
+	HYDROGRAPH AT	D380	6088.	5.58	2576.	674.	225.	15.11
+	ROUTED TO	RIW380	5792.	6.58	2574.	674.	225.	15.11
+	HYDROGRAPH AT	IW370	565.	4.50	164.	42.	14.	.88
+	2 COMBINED AT	CIW370	5961.	6.58	2714.	711.	237.	12.02
+	ROUTED TO	RIW370	5721.	7.08	2711.	711.	237.	12.02
+	HYDROGRAPH AT	IW349	243.	4.33	51.	13.	4.	.25
+	2 COMBINED AT	CIW349	5721.	7.08	2736.	720.	240.	12.27
+	DIVERSION TO	DO349	3547.	7.08	1697.	446.	149.	12.27
+	HYDROGRAPH AT	D349	2174.	7.08	1040.	273.	91.	12.27

+	ROUTED TO RIW349	2168.	7.17	1039.	273.	91.	12.27
+	HYDROGRAPH AT IW352	148.	4.17	19.	5.	2.	.10
+	3 COMBINED AT CIW352	2355.	7.17	1282.	339.	113.	6.39
+	HYDROGRAPH AT IW356	391.	4.25	70.	18.	6.	.29
+	HYDROGRAPH AT D349	3547.	7.08	1697.	446.	149.	12.27
+	ROUTED TO RD349	3450.	7.33	1694.	446.	149.	12.27
+	3 COMBINED AT CIW356	5643.	7.25	2937.	780.	260.	14.28
+	ROUTED TO RIW356	5595.	7.42	2932.	780.	260.	14.28
+	HYDROGRAPH AT IW354	579.	4.25	91.	23.	8.	.36
+	2 COMBINED AT CIW354	5595.	7.42	2989.	799.	266.	14.64
+	ROUTED TO RIW354	5506.	7.67	2978.	798.	266.	14.64
+	HYDROGRAPH AT IW362	260.	4.25	44.	11.	4.	.18
+	2 COMBINED AT CIW362	5506.	7.67	3001.	807.	269.	14.82
+	HYDROGRAPH AT IW372	504.	4.17	65.	16.	5.	.32
+	DIVERSION TO DO372	291.	4.17	25.	6.	2.	.32
+	HYDROGRAPH AT D372	214.	4.17	40.	10.	3.	.32
+	ROUTED TO RIW372	154.	5.33	40.	10.	3.	.32
+	HYDROGRAPH AT IW375	368.	4.75	151.	40.	13.	.66
+	HYDROGRAPH AT D372	291.	4.17	25.	6.	2.	.32
+	ROUTED TO RD372	201.	4.42	25.	6.	2.	.32
+	2 COMBINED AT CIW375	493.	4.58	172.	45.	15.	.85
+	ROUTED TO RIW375	442.	5.33	170.	45.	15.	.85
+	HYDROGRAPH AT IW364	1576.	4.33	301.	75.	25.	1.15
+	3 COMBINED AT CIW364	1433.	4.33	485.	127.	42.	2.13
+	2 COMBINED AT C364*	5578.	7.67	3345.	909.	303.	16.95
+	ROUTED TO RIW364	5475.	8.25	3330.	909.	303.	16.95
+	HYDROGRAPH AT IW342	273.	4.42	69.	18.	6.	.35
+	2 COMBINED AT CIW342	5474.	8.25	3359.	919.	307.	17.30
+	HYDROGRAPH AT IW351	342.	4.25	61.	15.	5.	.32
+	HYDROGRAPH AT D363	572.	5.08	291.	76.	25.	4.26
+	ROUTED TO RD363	565.	5.25	289.	76.	25.	4.26
	2 COMBINED AT						

+		CIW351	711.	4:92	357.	94.	31.	1.67
+	DIVERSION TO	DO351	612.	4.92	304.	79.	26.	1.67
+	HYDROGRAPH AT	D351	100.	4.92	54.	14.	5.	1.67
+	ROUTED TO	RIW351	79.	8.08	48.	14.	5.	1.67
+	HYDROGRAPH AT	IW346	2016.	4.75	587.	149.	50.	3.44
+	3 COMBINED AT	CIW346	5470.	8.25	3709.	1029.	343.	20.98
+	ROUTED TO	RIW346	5427.	8.50	3700.	1028.	343.	20.98
+	HYDROGRAPH AT	IW338	511.	4.25	74.	18.	6.	.34
+	2 COMBINED AT	CIW338	5425.	8.50	3727.	1041.	347.	21.32
+	ROUTED TO	RIW338	5353.	8.92	3702.	1039.	347.	21.32
+	HYDROGRAPH AT	IW326	473.	4.25	70.	18.	6.	.33
+	ROUTED TO	RIW326	361.	4.83	70.	18.	6.	.33
+	HYDROGRAPH AT	IW334	1579.	4.33	357.	90.	30.	1.26
+	3 COMBINED AT	CIW334	5351.	8.92	3863.	1127.	376.	22.91
+	ROUTED TO	SCP030	5311.	9.00	3830.	1119.	373.	22.91
+	ROUTED TO	RIW334	5220.	9.83	3757.	1118.	373.	22.91
+	HYDROGRAPH AT	IW302	904.	4.75	354.	94.	31.	1.33
+	2 COMBINED AT	CIW302	5220.	9.83	3849.	1191.	398.	24.24
+	DIVERSION TO	DO302	5212.	9.83	3841.	1189.	397.	24.24
+	HYDROGRAPH AT	D302	0.	.00	0.	0.	0.	24.24
+	HYDROGRAPH AT	IW361	326.	4.42	77.	20.	7.	.35
+	HYDROGRAPH AT	D351	612.	4.92	304.	79.	26.	1.67
+	ROUTED TO	RD351	605.	5.25	301.	79.	26.	1.67
+	4 COMBINED AT	CIW361	1854.	5.42	1013.	269.	90.	4.76
+	ROUTED TO	RIW361	1833.	6.17	999.	269.	90.	4.76
+	2 COMBINED AT	C350*	6672.	5.75	3622.	1001.	334.	22.22
+	ROUTED TO	R350*	6570.	6.00	3601.	1001.	334.	22.22
+	HYDROGRAPH AT	IW330	781.	4.58	210.	53.	18.	1.04
+	2 COMBINED AT	CIW330	6677.	6.00	3686.	1033.	344.	23.25
+	ROUTED TO	RIW330	6589.	6.17	3670.	1033.	344.	23.25
+	HYDROGRAPH AT	IW322	1149.	4.83	464.	121.	40.	1.89
+	2 COMBINED AT	CIW322	7020.	6.17	3960.	1123.	374.	25.14

+	ROUTED TO	RIW322	6874.	6.83	3917.	1122.	374.	25.14
+	HYDROGRAPH AT	IW318	561.	4.50	148.	37.	12.	.58
+	ROUTED TO	RIW318	421.	6.17	144.	37.	12.	.58
+	HYDROGRAPH AT	IW310	921.	4.67	302.	78.	26.	1.17
+	2 COMBINED AT	CIW310	891.	4.67	427.	113.	38.	1.75
+	ROUTED TO	RIW310	887.	4.75	427.	113.	38.	1.75
+	HYDROGRAPH AT	IW314	1532.	4.75	565.	148.	49.	2.18
+	3 COMBINED AT	CIW314	7448.	6.75	4360.	1315.	439.	29.07
+	ROUTED TO	SCP020	7279.	7.00	3977.	1309.	437.	29.07
+	ROUTED TO	RIW314	6831.	8.17	3967.	1308.	437.	29.07
+	HYDROGRAPH AT	IW300	1000.	4.75	336.	87.	29.	1.48
+	2 COMBINED AT	CIW300	6819.	8.17	3965.	1363.	457.	30.55
+	ROUTED TO	RIW300	6703.	8.42	3956.	1361.	456.	30.55
+	HYDROGRAPH AT	D302	5212.	9.83	3841.	1189.	397.	24.24
+	2 COMBINED AT	C302*	9876.	9.17	6824.	2315.	775.	54.72
+	ROUTED TO	RIW302	9849.	9.50	6817.	2315.	775.	54.72
+	HYDROGRAPH AT	SV264A	2107.	4.83	753.	196.	65.	2.90
+	ROUTED TO	R264A	1855.	5.25	743.	196.	65.	2.90
+	HYDROGRAPH AT	SV264	1603.	4.67	472.	120.	40.	1.92
+	2 COMBINED AT	CSV264	3000.	5.00	1164.	305.	102.	4.82
+	ROUTED TO	RSV264	2648.	5.42	1146.	305.	102.	4.82
+	HYDROGRAPH AT	SV298	667.	4.75	267.	70.	23.	1.08
+	ROUTED TO	RSV298	613.	5.92	261.	70.	23.	1.08
+	HYDROGRAPH AT	SV286	1504.	4.50	419.	107.	36.	1.54
+	ROUTED TO	RSV286	1412.	4.75	417.	107.	36.	1.54
+	HYDROGRAPH AT	SV284	495.	4.25	82.	21.	7.	.28
+	2 COMBINED AT	CSV284	1635.	4.67	492.	126.	42.	1.82
+	ROUTED TO	RSV284	1422.	5.33	488.	126.	42.	1.82
+	HYDROGRAPH AT	SV290	914.	4.42	206.	52.	17.	.81
+	ROUTED TO	RSV290	637.	5.42	203.	52.	17.	.81
+	HYDROGRAPH AT	SV272	1193.	4.42	271.	68.	23.	1.20
+	3 COMBINED AT	CSV272	2342.	5.25	908.	235.	78.	3.84

ROUTED TO	RSV272	2326.	5.33	908.	235.	78.	3.84
HYDROGRAPH AT	SV294	2178.	4.67	716.	184.	61.	2.65
ROUTED TO	RSV294	1952.	5.42	711.	184.	61.	2.65
HYDROGRAPH AT	SV276	874.	4.50	221.	56.	19.	.92
3 COMBINED AT	CSV276	4303.	5.42	1729.	450.	150.	7.41
ROUTED TO	RSV276	4299.	5.42	1729.	450.	150.	7.41
HYDROGRAPH AT	SV280	890.	4.58	260.	66.	22.	1.06
3 COMBINED AT	CSV280	4905.	5.50	2148.	566.	189.	9.54
ROUTED TO	RSV280	4807.	5.75	2145.	566.	189.	9.54
HYDROGRAPH AT	SV268	1618.	4.42	372.	94.	31.	1.38
ROUTED TO	RSV268	1386.	4.75	371.	94.	31.	1.38
HYDROGRAPH AT	SV260	1354.	4.42	272.	68.	23.	1.26
4 COMBINED AT	CSV260	7564.	5.58	3611.	962.	321.	16.99
ROUTED TO	SCP010	4946.	6.67	3470.	959.	320.	16.99
ROUTED TO	RSV260	4937.	6.92	3460.	959.	320.	16.99
HYDROGRAPH AT	SV220	1101.	4.17	155.	39.	13.	.60
HYDROGRAPH AT	SV252	162.	4.25	30.	8.	3.	.15
ROUTED TO	RSV252	106.	5.17	30.	8.	3.	.15
HYDROGRAPH AT	SV254	171.	4.17	24.	6.	2.	.10
ROUTED TO	RSV254	96.	5.08	24.	6.	2.	.10
HYDROGRAPH AT	SV219	1179.	4.33	230.	58.	19.	.90
3 COMBINED AT	CSV219	1150.	4.33	273.	70.	23.	1.14
ROUTED TO	RSV219	975.	4.83	273.	70.	23.	1.14
HYDROGRAPH AT	SV251	308.	4.25	49.	12.	4.	.27
ROUTED TO	RSV251	205.	5.25	49.	12.	4.	.27
HYDROGRAPH AT	SV250	157.	4.17	24.	6.	2.	.12
ROUTED TO	RSV250	98.	5.25	24.	6.	2.	.12
HYDROGRAPH AT	SV218	1225.	4.42	255.	64.	21.	1.29
4 COMBINED AT	CSV218	1834.	4.75	558.	143.	48.	2.82
ROUTED TO	RSV218	1726.	5.08	557.	143.	48.	2.82
HYDROGRAPH AT	SV248	1058.	4.67	277.	71.	24.	1.27
DIVERSION TO							

+	DO248	497.	4.67	130.	33.	11.	1.27
+ HYDROGRAPH AT	D248	561.	4.67	147.	37.	12.	1.27
+ ROUTED TO	RSV248	489.	5.17	146.	37.	12.	1.27
+ HYDROGRAPH AT	SV244	640.	4.92	210.	54.	18.	.95
+ 2 COMBINED AT	CSV244	1053.	5.08	348.	89.	30.	1.62
+ HYDROGRAPH AT	SV246	285.	4.17	39.	10.	3.	.16
+ HYDROGRAPH AT	D248	497.	4.67	130.	33.	11.	1.27
+ ROUTED TO	RD248	460.	5.00	130.	33.	11.	1.27
+ 2 COMBINED AT	CSV246	555.	4.92	172.	44.	15.	.76
+ 2 COMBINED AT	C216*	1480.	5.00	500.	129.	43.	2.38
+ ROUTED TO	RSV244	1374.	5.75	498.	129.	43.	2.38
+ HYDROGRAPH AT	SV216	1781.	4.33	332.	83.	28.	1.63
+ 3 COMBINED AT	CSV216	2753.	5.33	1240.	323.	108.	6.82
+ ROUTED TO	RSV216	2722.	5.75	1237.	323.	108.	6.82
+ HYDROGRAPH AT	SV236	760.	4.25	107.	27.	9.	.59
+ ROUTED TO	RSV236	414.	5.50	107.	27.	9.	.59
+ HYDROGRAPH AT	SV240	3008.	4.75	686.	173.	58.	3.67
+ HYDROGRAPH AT	SV242	94.	4.25	17.	4.	1.	.09
+ 2 COMBINED AT	C242*	3039.	4.75	697.	176.	59.	3.76
+ ROUTED TO	R242*	2794.	5.33	696.	176.	59.	3.76
+ HYDROGRAPH AT	SV214	2185.	4.33	438.	110.	37.	1.87
+ 6 COMBINED AT	CSV220	7777.	5.83	5053.	1425.	475.	30.63
+ ROUTED TO	RSV220	7745.	6.25	5031.	1425.	475.	30.63
+ HYDROGRAPH AT	SV230	1580.	4.17	193.	48.	16.	.85
+ HYDROGRAPH AT	SV232	2915.	4.58	603.	152.	51.	3.06
+ 2 COMBINED AT	C230*	3427.	4.50	764.	192.	64.	3.91
+ ROUTED TO	R230*	3271.	4.92	760.	192.	64.	3.91
+ HYDROGRAPH AT	SV212	3358.	4.50	821.	208.	69.	4.14
+ 3 COMBINED AT	CSV212	8643.	5.83	5829.	1680.	560.	38.68
+ ROUTED TO	RSV212	8505.	6.42	5763.	1680.	560.	38.68
+ HYDROGRAPH AT	SV202	1314.	4.58	356.	90.	30.	1.44
+ ROUTED TO	RSV202	1253.	4.92	355.	90.	30.	1.44

+ HYDROGRAPH AT	SV210	1606.	4.08	189.	47.	16.	.72
+ ROUTED TO	RSV210	1000.	5.00	188.	47.	16.	.72
+ 3 COMBINED AT	C210*	8907.	6.33	6034.	1770.	590.	40.83
+ HYDROGRAPH AT	SV208	889.	4.67	221.	56.	19.	1.07
+ HYDROGRAPH AT	SV205	1095.	4.17	109.	27.	9.	.50
+ 2 COMBINED AT	C205*	1162.	4.50	314.	80.	27.	1.57
+ ROUTED TO	R205*	798.	5.00	311.	80.	27.	1.57
+ HYDROGRAPH AT	SV203	170.	4.08	11.	3.	1.	.08
+ ROUTED TO	RSV203	97.	4.67	11.	3.	1.	.08
+ 3 COMBINED AT	C200*	9128.	6.25	6165.	1814.	605.	42.48
+ HYDROGRAPH AT	SV200	2363.	4.42	564.	143.	48.	2.29
+ 3 COMBINED AT	CSV200	12735.	9.17	10756.	3730.	1249.	99.49
+ ROUTED TO	RSV200	12703.	9.42	10746.	3730.	1249.	99.49
+ HYDROGRAPH AT	TW416	677.	4.42	186.	48.	16.	.59
+ ROUTED TO	RTW416	583.	5.58	185.	48.	16.	.59
+ HYDROGRAPH AT	TW420	923.	4.42	243.	62.	21.	.81
+ ROUTED TO	RTW420	830.	5.17	242.	62.	21.	.81
+ HYDROGRAPH AT	TW412	1762.	4.67	588.	153.	51.	2.06
+ 2 COMBINED AT	CTW412	2214.	5.00	812.	212.	71.	2.87
+ HYDROGRAPH AT	TW414	2227.	4.08	235.	59.	20.	1.17
+ ROUTED TO	RTW414	1109.	5.08	231.	59.	20.	1.17
+ HYDROGRAPH AT	TW410	290.	4.42	78.	20.	7.	.31
+ 2 COMBINED AT	CTW410	1235.	5.08	296.	77.	26.	1.48
+ 4 COMBINED AT	C410*	12703.	9.42	11148.	3941.	1320.	104.42
+ ROUTED TO	RTW410	12502.	10.00	11021.	3909.	1309.	104.42
+ HYDROGRAPH AT	TW402	3774.	4.75	1221.	315.	105.	4.91
+ 3 COMBINED AT	CTW402	14148.	7.58	12195.	4463.	1496.	135.06
+ ROUTED TO	RTW402	14080.	7.75	12175.	4462.	1496.	135.06
+ HYDROGRAPH AT	TW448	281.	4.58	93.	24.	8.	.35
+ DIVERSION TO	DO448	124.	4.58	18.	4.	1.	.35
+ HYDROGRAPH AT	D448	157.	4.58	75.	19.	6.	.35
+ ROUTED TO	RTW448	155.	5.58	74.	19.	6.	.35

+ HYDROGRAPH AT	TW446A	309.	4.50	90.	23.	8.	.34
+ HYDROGRAPH AT	D448	124.	4.58	18.	4.	1.	.35
+ ROUTED TO	RD448	113.	4.75	18.	4.	1.	.35
+ 2 COMBINED AT	C446A	408.	4.58	108.	28.	9.	.50
+ DIVERSION TO	DO446A	12.	4.58	0.	0.	0.	.50
+ HYDROGRAPH AT	D446A	397.	4.58	108.	27.	9.	.50
+ ROUTED TO	R446A	359.	5.17	107.	27.	9.	.50
+ HYDROGRAPH AT	TW446	503.	4.25	95.	24.	8.	.35
+ 3 COMBINED AT	CTW446	664.	5.00	270.	70.	23.	1.01
+ ROUTED TO	RTW446	634.	5.50	267.	70.	23.	1.01
+ HYDROGRAPH AT	TW432	778.	4.42	169.	43.	14.	.86
+ 2 COMBINED AT	CTW432	996.	4.75	418.	109.	36.	1.87
+ ROUTED TO	RTW432	957.	5.42	415.	109.	36.	1.87
+ HYDROGRAPH AT	TW431	922.	4.42	211.	53.	18.	.87
+ 2 COMBINED AT	CTW431	1443.	4.92	603.	158.	53.	2.75
+ HYDROGRAPH AT	TW459	472.	4.83	188.	49.	16.	1.04
+ ROUTED TO	SSR350	471.	4.83	188.	49.	16.	1.04
+ ROUTED TO	RTW459	466.	5.08	187.	49.	16.	1.04
+ HYDROGRAPH AT	TW462	179.	4.08	20.	5.	2.	.08
+ HYDROGRAPH AT	D380	2563.	5.58	389.	97.	32.	15.11
+ ROUTED TO	RD380	2432.	5.67	389.	97.	32.	15.11
+ 2 COMBINED AT	CTW462	3373.	5.67	601.	150.	50.	4.05
+ ROUTED TO	SSR330	3372.	5.58	601.	150.	50.	4.05
+ ROUTED TO	RTW462	2987.	6.00	601.	150.	50.	4.05
+ HYDROGRAPH AT	TW450A	927.	4.67	207.	52.	17.	.88
+ ROUTED TO	SSR410	868.	4.83	207.	52.	17.	.88
+ ROUTED TO	R450A	786.	5.08	206.	52.	17.	.88
+ HYDROGRAPH AT	TW450B	626.	4.25	105.	26.	9.	.40
+ 4 COMBINED AT	C450B	3447.	5.92	963.	244.	81.	6.38
+ ROUTED TO	R450B	3206.	6.58	957.	244.	81.	6.38
+ HYDROGRAPH AT	TW450	825.	4.83	315.	81.	27.	1.25
HYDROGRAPH AT							

	D446A	12.	4.58	0.	0.	0.	.50
ROUTED TO	RD446A	3.	4.75	0.	0.	0.	.50
3 COMBINED AT	CTW450	3391.	6.50	1204.	311.	104.	7.62
DIVERSION TO	DO450	269.	6.50	39.	10.	3.	7.62
HYDROGRAPH AT	D450	3122.	6.50	1165.	301.	100.	7.62
ROUTED TO	RTW450	3040.	6.83	1160.	301.	100.	7.62
HYDROGRAPH AT	TW444	514.	4.25	79.	20.	7.	.35
2 COMBINED AT	CTW444	3064.	6.83	1219.	320.	107.	7.29
ROUTED TO	RTW444	3011.	7.00	1216.	320.	107.	7.29
HYDROGRAPH AT	TW440	193.	4.17	24.	6.	2.	.11
2 COMBINED AT	CTW440	3006.	7.00	1228.	324.	108.	7.40
HYDROGRAPH AT	TW460	1362.	5.00	419.	107.	36.	2.32
ROUTED TO	SSR540	1213.	4.83	378.	96.	32.	2.32
ROUTED TO	RTW460	1176.	5.25	378.	96.	32.	2.32
HYDROGRAPH AT	TW458	991.	4.50	170.	43.	14.	.67
2 COMBINED AT	CTW458	1658.	5.08	568.	145.	48.	2.99
ROUTED TO	RTW458	1641.	5.25	568.	145.	48.	2.99
HYDROGRAPH AT	TW456	167.	4.33	38.	10.	3.	.18
2 COMBINED AT	CTW456	1698.	5.25	598.	153.	51.	3.16
ROUTED TO	RTW456	1660.	5.42	597.	153.	51.	3.16
HYDROGRAPH AT	TW454	188.	4.67	72.	19.	6.	.36
2 COMBINED AT	CTW454	1758.	5.42	651.	167.	56.	3.52
DIVERSION TO	DO454	1125.	5.42	416.	107.	36.	3.52
HYDROGRAPH AT	D454	633.	5.42	234.	60.	20.	3.52
ROUTED TO	RTW454	589.	6.17	232.	60.	20.	3.52
HYDROGRAPH AT	TW452A	1073.	4.67	256.	64.	21.	1.08
ROUTED TO	SSR450	1056.	4.75	256.	64.	21.	1.08
ROUTED TO	R452A	918.	5.58	255.	64.	21.	1.08
HYDROGRAPH AT	TW452B	784.	4.67	248.	63.	21.	1.03
3 COMBINED AT	C452B	1579.	5.92	702.	182.	61.	3.38
ROUTED TO	R452B	1513.	6.33	696.	182.	61.	3.38
HYDROGRAPH AT	TW452	447.	4.50	124.	31.	10.	.46

+ HYDROGRAPH AT	D450	269.	6.50	39.	10.	3.	7.62
+ ROUTED TO	RD450	243.	6.75	39.	10.	3.	7.62
+ 3 COMBINED AT	CTW452	1787.	6.50	837.	220.	73.	4.52
+ ROUTED TO	RTW452	1743.	6.92	833.	220.	73.	4.52
+ HYDROGRAPH AT	TW442	567.	4.25	92.	23.	8.	.38
+ 2 COMBINED AT	CTW442	1738.	6.92	885.	241.	80.	4.90
+ 2 COMBINED AT	C442*	4221.	7.00	1929.	518.	173.	12.29
+ ROUTED TO	R442*	4032.	7.50	1919.	518.	173.	12.29
+ HYDROGRAPH AT	TW434	642.	4.33	122.	31.	10.	.57
+ 3 COMBINED AT	CTW434	4176.	7.50	2392.	662.	221.	15.61
+ ROUTED TO	RTW434	4056.	8.00	2383.	662.	221.	15.61
+ HYDROGRAPH AT	TW436	1007.	4.25	162.	41.	14.	.67
+ ROUTED TO	RTW436	779.	5.17	162.	41.	14.	.67
+ HYDROGRAPH AT	TW430	2852.	4.33	559.	140.	47.	2.49
+ HYDROGRAPH AT	TW429	749.	4.33	149.	38.	13.	.56
+ ROUTED TO	RTW429	476.	5.00	146.	38.	13.	.56
+ 4 COMBINED AT	C430*	4054.	8.00	2947.	840.	280.	19.33
+ HYDROGRAPH AT	TW485	1789.	4.58	484.	123.	41.	2.37
+ HYDROGRAPH AT	D454	1125.	5.42	416.	107.	36.	3.52
+ ROUTED TO	RD454	1104.	5.50	416.	107.	36.	3.52
+ HYDROGRAPH AT	WI576A	770.	4.83	227.	58.	19.	1.22
+ ROUTED TO	R576A	716.	5.33	226.	58.	19.	1.22
+ HYDROGRAPH AT	WI576B	504.	4.33	99.	25.	8.	.46
+ 2 COMBINED AT	C576B	837.	5.25	307.	79.	26.	1.69
+ DIVERSION TO	DO576B	335.	5.25	123.	32.	11.	1.69
+ HYDROGRAPH AT	D576B	502.	5.25	184.	47.	16.	1.69
+ ROUTED TO	R576B	388.	7.08	181.	47.	16.	1.69
+ 3 COMBINED AT	CTW485	2060.	4.92	986.	258.	86.	5.64
+ ROUTED TO	RTW485	2038.	5.17	985.	258.	86.	5.64
+ HYDROGRAPH AT	TW484	395.	4.33	92.	24.	8.	.35
+ 2 COMBINED AT	CTW484	2213.	5.00	1055.	278.	93.	5.99
+ ROUTED TO	RTW484	2164.	5.67	1047.	278.	93.	5.99

+	HYDROGRAPH AT	WI580A	1942.	4.58	505.	127.	42.	2.79
+	HYDROGRAPH AT	WI580B	647.	4.33	129.	33.	11.	.63
+	DIVERSION TO	DO580B	298.	4.33	60.	15.	5.	.63
+	HYDROGRAPH AT	D580B	349.	4.33	70.	18.	6.	.63
+	ROUTED TO	R580B	314.	4.75	70.	18.	6.	.63
+	2 COMBINED AT	C580A	2129.	4.67	560.	141.	47.	3.13
+	ROUTED TO	SSR630	2127.	4.67	560.	141.	47.	3.13
+	ROUTED TO	R580A	1880.	5.67	558.	141.	47.	3.13
+	HYDROGRAPH AT	WI580	1552.	4.25	255.	64.	21.	1.32
+	HYDROGRAPH AT	D580B	298.	4.33	60.	15.	5.	.63
+	ROUTED TO	RD580B	266.	4.75	59.	15.	5.	.63
+	HYDROGRAPH AT	WI578	454.	4.42	98.	25.	8.	.48
+	2 COMBINED AT	CWI578	616.	4.67	153.	39.	13.	.77
+	ROUTED TO	SSR700	558.	4.83	153.	39.	13.	.77
+	ROUTED TO	RWI578	525.	5.42	152.	39.	13.	.77
+	3 COMBINED AT	CWI580	2253.	5.67	864.	222.	74.	5.22
+	ROUTED TO	RWI580	2156.	6.08	861.	222.	74.	5.22
+	HYDROGRAPH AT	D576B	335.	5.25	123.	32.	11.	1.69
+	ROUTED TO	RD576B	283.	6.42	121.	32.	11.	1.69
+	HYDROGRAPH AT	WI576	910.	4.50	215.	54.	18.	1.18
+	3 COMBINED AT	CWI576	2439.	6.08	1099.	286.	95.	7.07
+	DIVERSION TO	DO576	960.	6.08	434.	113.	38.	7.07
+	HYDROGRAPH AT	D576	1479.	6.08	666.	173.	58.	7.07
+	ROUTED TO	RWI576	1421.	6.50	662.	173.	58.	7.07
+	HYDROGRAPH AT	TW482	1039.	4.33	220.	56.	19.	.76
+	2 COMBINED AT	CTW482	1553.	6.42	851.	232.	77.	5.04
+	DIVERSION TO	DO482	0.	.00	0.	0.	0.	5.04
+	HYDROGRAPH AT	D482	1553.	6.42	851.	232.	77.	5.04
+	ROUTED TO	RTW482	1504.	6.83	845.	232.	77.	5.04
+	HYDROGRAPH AT	TW480	1006.	4.33	182.	46.	15.	.75
+	3 COMBINED AT	CTW480	3279.	5.58	1863.	511.	170.	11.78
	ROUTED TO							

+	RTW480	3162.	5.92	1855.	511.	170.	11.78
+ HYDROGRAPH AT	TW478	470.	4.17	61.	15.	5.	.26
+ 2 COMBINED AT	CTW478	3162.	5.92	1881.	522.	174.	12.04
+ ROUTED TO	RTW478	3065.	6.50	1848.	522.	174.	12.04
+ 2 COMBINED AT	CTW430	5596.	7.75	4113.	1201.	401.	31.37
+ ROUTED TO	SCP040	5234.	7.92	3521.	1181.	394.	31.37
+ ROUTED TO	RTW430	4755.	8.42	3469.	1180.	394.	31.37
+ HYDROGRAPH AT	TW418	1835.	4.33	413.	104.	35.	1.37
+ 2 COMBINED AT	CTW418	4725.	8.50	3469.	1259.	423.	32.74
+ ROUTED TO	RTW418	4478.	8.75	3413.	1252.	421.	32.74
+ HYDROGRAPH AT	TW424	2372.	4.25	390.	98.	33.	1.50
+ ROUTED TO	RTW424	2163.	4.50	388.	98.	33.	1.50
+ HYDROGRAPH AT	TW422	791.	4.42	202.	52.	17.	.70
+ 3 COMBINED AT	CTW422	4440.	8.75	3412.	1365.	459.	34.94
+ ROUTED TO	RTW422	3998.	10.25	3298.	1353.	455.	34.94
+ HYDROGRAPH AT	TW400	3162.	4.83	1171.	307.	102.	4.27
+ 3 COMBINED AT	CTW400	14449.	7.75	12998.	5167.	1737.	174.27
+ ROUTED TO	RTW400	14378.	8.00	12968.	5165.	1737.	174.27
+ HYDROGRAPH AT	WI504	1612.	4.33	298.	75.	25.	1.35
+ 2 COMBINED AT	CWI504	14378.	8.00	12976.	5200.	1749.	175.62
+ ROUTED TO	RWI504	14313.	8.08	12929.	5186.	1745.	175.62
+ HYDROGRAPH AT	D576	960.	6.08	434.	113.	38.	7.07
+ ROUTED TO	RD576	935.	6.33	432.	113.	38.	7.07
+ HYDROGRAPH AT	WI574	311.	4.17	45.	11.	4.	.22
+ ROUTED TO	RWI574	188.	5.25	45.	11.	4.	.22
+ HYDROGRAPH AT	WI572	1905.	4.42	434.	110.	37.	2.06
+ ROUTED TO	RWI572	1639.	5.17	431.	110.	37.	2.06
+ HYDROGRAPH AT	WI570	1732.	4.58	497.	127.	42.	2.24
+ DIVERSION TO	DO570	364.	4.58	104.	27.	9.	2.24
+ HYDROGRAPH AT	D570	1368.	4.58	393.	100.	33.	2.24
+ ROUTED TO	RWI570	1302.	5.00	391.	100.	33.	2.24
+ HYDROGRAPH AT	WI566	152.	4.25	22.	6.	2.	.11

+	HYDROGRAPH AT	D570	364.	4.58	104.	27.	9.	2.24
+	2 COMBINED AT	CWI566	541.	4.42	133.	34.	11.	.58
+	ROUTED TO	SSR830	531.	4.50	133.	34.	11.	.58
+	ROUTED TO	RWI566	498.	5.00	133.	34.	11.	.58
+	HYDROGRAPH AT	WI564	977.	5.25	358.	93.	31.	1.81
+	ROUTED TO	SSR880	976.	5.25	358.	93.	31.	1.81
+	ROUTED TO	RWI564	941.	5.58	356.	93.	31.	1.81
+	HYDROGRAPH AT	WI562	713.	4.50	196.	49.	16.	.87
+	3 COMBINED AT	CWI562	1537.	5.42	637.	166.	55.	3.26
+	2 COMBINED AT	C562*	2507.	5.25	981.	255.	85.	5.03
+	ROUTED TO	R562*	2423.	5.92	973.	255.	85.	5.03
+	HYDROGRAPH AT	WI560A	986.	4.83	372.	96.	32.	2.04
+	ROUTED TO	R560A	909.	5.67	368.	96.	32.	2.04
+	HYDROGRAPH AT	WI560	3069.	4.58	844.	215.	72.	3.56
+	6 COMBINED AT	CWI560	5204.	5.58	2601.	704.	235.	15.70
+	ROUTED TO	RWI560	5096.	6.25	2590.	704.	235.	15.70
+	HYDROGRAPH AT	WI582	605.	4.25	110.	28.	9.	.38
+	HYDROGRAPH AT	D482	0.	.00	0.	0.	0.	5.04
+	ROUTED TO	RD482	0.	.00	0.	0.	0.	5.04
+	2 COMBINED AT	CWI582	605.	4.25	110.	28.	9.	.38
+	ROUTED TO	RWI582	428.	4.67	109.	28.	9.	.38
+	HYDROGRAPH AT	WI556	237.	4.00	25.	6.	2.	.08
+	ROUTED TO	RWI556	63.	5.25	24.	6.	2.	.08
+	HYDROGRAPH AT	WI554	1217.	4.33	271.	69.	23.	1.04
+	4 COMBINED AT	CWI554	5258.	6.17	2826.	782.	261.	17.20
+	ROUTED TO	RWI554	5247.	6.25	2824.	782.	261.	17.20
+	HYDROGRAPH AT	WI552	503.	4.25	96.	24.	8.	.41
+	2 COMBINED AT	CWI552	5256.	6.25	2872.	798.	266.	17.61
+	ROUTED TO	RWI552	5249.	6.33	2871.	798.	266.	17.61
+	HYDROGRAPH AT	WI584	1115.	4.50	267.	68.	23.	1.26
+	ROUTED TO	RWI584	1061.	4.67	267.	68.	23.	1.26
+	HYDROGRAPH AT	WI550	350.	4.08	43.	11.	4.	.14

3 COMBINED AT	CWI550	5340.	6.25	3052.	850.	284.	19.01
ROUTED TO	SCP050	5198.	6.58	3052.	850.	284.	19.01
ROUTED TO	RWI550	5050.	6.92	3045.	850.	284.	19.01
HYDROGRAPH AT	WI514	660.	4.17	87.	22.	7.	.35
2 COMBINED AT	CWI514	5050.	6.92	3089.	867.	289.	19.36
HYDROGRAPH AT	WI548	471.	4.25	74.	19.	6.	.31
ROUTED TO	RWI548	331.	5.08	74.	19.	6.	.31
HYDROGRAPH AT	WI546	710.	4.33	175.	45.	15.	.61
2 COMBINED AT	CWI546	731.	4.83	242.	62.	21.	.91
ROUTED TO	RWI546	718.	5.00	242.	62.	21.	.91
HYDROGRAPH AT	WI544	1716.	4.50	466.	119.	40.	1.79
2 COMBINED AT	CWI544	2147.	4.58	687.	177.	59.	2.71
DIVERSION TO	DO544	1438.	4.58	460.	119.	40.	2.71
HYDROGRAPH AT	D544	708.	4.58	227.	58.	19.	2.71
ROUTED TO	RWI544	638.	5.25	225.	58.	19.	2.71
HYDROGRAPH AT	WI542	903.	4.50	268.	69.	23.	1.17
2 COMBINED AT	CWI542	1271.	5.00	482.	126.	42.	2.06
HYDROGRAPH AT	WI540	1075.	4.75	293.	75.	25.	1.25
ROUTED TO	SSR940	1075.	4.83	293.	75.	25.	1.25
ROUTED TO	RWI540	1025.	4.92	293.	75.	25.	1.25
HYDROGRAPH AT	WI538A	764.	4.67	190.	48.	16.	.78
2 COMBINED AT	C538A	1598.	4.92	470.	120.	40.	2.02
ROUTED TO	R538A	1467.	5.58	468.	120.	40.	2.02
HYDROGRAPH AT	WI538	948.	4.83	385.	102.	34.	1.43
2 COMBINED AT	CWI538	2102.	5.50	822.	216.	72.	3.45
ROUTED TO	RWI538	2009.	6.08	817.	216.	72.	3.45
HYDROGRAPH AT	WI536	928.	4.83	406.	110.	37.	1.37
HYDROGRAPH AT	WI534	616.	4.33	144.	37.	12.	.43
ROUTED TO	RWI534	577.	4.58	144.	37.	12.	.43
HYDROGRAPH AT	WI532	580.	4.17	104.	26.	9.	.32
2 COMBINED AT	CWI532	972.	4.42	245.	63.	21.	.76
2 COMBINED AT							

+	C530*	1662.	4.58	634.	171.	57.	2.13
+ ROUTED TO	R530*	1600.	5.25	632.	171.	57.	2.13
+ HYDROGRAPH AT	WI530	1709.	4.50	417.	106.	35.	2.38
+ HYDROGRAPH AT	D544	1438.	4.58	460.	119.	40.	2.71
+ ROUTED TO	RD544	1354.	5.17	458.	119.	40.	2.71
+ 4 COMBINED AT	CWI530	3977.	5.25	2082.	563.	188.	9.78
+ 2 COMBINED AT	CAP1*	4886.	5.25	2465.	668.	223.	11.84
+ HYDROGRAPH AT	PI663	468.	4.83	150.	38.	13.	.60
+ ROUTED TO	RPI663	428.	5.50	148.	38.	13.	.60
+ HYDROGRAPH AT	PI657	583.	4.75	223.	58.	19.	.87
+ HYDROGRAPH AT	PI660	432.	4.92	199.	54.	18.	.84
+ 3 COMBINED AT	CPI660	1172.	5.33	547.	145.	48.	2.31
+ ROUTED TO	RPI660	1157.	5.50	545.	145.	48.	2.31
+ HYDROGRAPH AT	PI654	2599.	4.92	965.	246.	82.	4.03
+ 2 COMBINED AT	CPI654	3352.	5.08	1447.	378.	126.	6.34
+ DIVERSION TO	DO654	670.	5.08	289.	76.	25.	6.34
+ HYDROGRAPH AT	D654	2682.	5.08	1157.	302.	101.	6.34
+ ROUTED TO	RPI654	2660.	5.33	1154.	302.	101.	6.34
+ HYDROGRAPH AT	PI648	1246.	4.75	425.	109.	36.	1.73
+ HYDROGRAPH AT	PI651	436.	4.42	108.	27.	9.	.46
+ 3 COMBINED AT	CPI651	3811.	5.17	1621.	424.	141.	7.26
+ ROUTED TO	RPI651	3757.	5.42	1618.	424.	141.	7.26
+ HYDROGRAPH AT	PI645A	1175.	4.75	434.	113.	38.	1.63
+ ROUTED TO	R645A	1151.	5.08	433.	113.	38.	1.63
+ HYDROGRAPH AT	PI645	1316.	4.42	258.	65.	22.	1.56
+ HYDROGRAPH AT	D654	670.	5.08	289.	76.	25.	6.34
+ ROUTED TO	RD654	656.	5.58	287.	76.	25.	6.34
+ 4 COMBINED AT	CPI645	5404.	5.33	2410.	637.	212.	11.72
+ 2 COMBINED AT	CAP1*	9326.	5.33	4518.	1219.	406.	23.56
+ HYDROGRAPH AT	PI689	5150.	5.08	1584.	407.	136.	6.78
+ HYDROGRAPH AT	PI688	2857.	4.83	742.	189.	63.	3.20
+ 2 COMBINED AT	CPI689	7228.	5.00	2219.	570.	190.	9.98

+	ROUTED TO	RPI689	6946.	5.33	2208.	570.	190.	9.98
+	HYDROGRAPH AT	PI687	4438.	5.17	1401.	362.	121.	7.01
+	2 COMBINED AT	CPI687	10250.	5.33	3393.	881.	294.	16.99
+	ROUTED TO	RPI687	10057.	5.50	3386.	881.	294.	16.99
+	HYDROGRAPH AT	PI684	871.	4.58	178.	45.	15.	.74
+	2 COMBINED AT	CPI684	10270.	5.50	3512.	913.	304.	17.73
+	ROUTED TO	SSR103	10047.	5.58	3512.	913.	304.	17.73
+	ROUTED TO	RPI684	9778.	5.92	3506.	913.	304.	17.73
+	HYDROGRAPH AT	PI681	798.	4.67	268.	69.	23.	.99
+	2 COMBINED AT	CPI681	10009.	5.92	3702.	967.	322.	18.72
+	ROUTED TO	RPI681	9568.	6.50	3691.	967.	322.	18.72
+	HYDROGRAPH AT	PI678	708.	4.50	230.	60.	20.	.83
+	2 COMBINED AT	CPI678	9652.	6.50	3814.	1013.	338.	19.55
+	DIVERSION TO	DO678	2702.	6.50	1068.	284.	95.	19.55
+	HYDROGRAPH AT	D678	6949.	6.50	2746.	729.	243.	19.55
+	HYDROGRAPH AT	PI690	478.	4.50	134.	34.	11.	.63
+	2 COMBINED AT	CPI690	7346.	6.42	2924.	779.	260.	14.71
+	ROUTED TO	RPI690	7158.	6.58	2912.	779.	260.	14.71
+	HYDROGRAPH AT	PI675	106.	4.17	13.	3.	1.	.06
+	2 COMBINED AT	CPI675	7156.	6.58	2915.	781.	260.	14.77
+	2 COMBINED AT	CAP1*	12086.	6.42	6733.	1836.	612.	38.33
+	HYDROGRAPH AT	PI672	1306.	4.42	260.	65.	22.	1.51
+	HYDROGRAPH AT	D678	2702.	6.50	1068.	284.	95.	19.55
+	ROUTED TO	RD678	2378.	6.92	1058.	284.	95.	19.55
+	2 COMBINED AT	CPI672	2753.	6.83	1329.	364.	121.	6.98
+	2 COMBINED AT	CAP1*	13388.	6.50	7612.	2086.	695.	45.31
+	HYDROGRAPH AT	PI693	980.	4.25	157.	39.	13.	.84
+	2 COMBINED AT	CAP1*	13363.	6.50	7672.	2103.	701.	46.15
+	HYDROGRAPH AT	PI669	223.	4.42	57.	14.	5.	.29
+	2 COMBINED AT	CAP1*	13356.	6.50	7688.	2108.	703.	46.43
+	HYDROGRAPH AT	PI642	278.	4.25	44.	11.	4.	.24
+	2 COMBINED AT	CAP1*	13347.	6.50	7700.	2112.	704.	46.67

+	HYDROGRAPH AT	PDWEST	4407.	5.17	1467.	381.	127.	7.08
+	2 COMBINED AT	CAP1*	14655.	6.42	8944.	2450.	817.	53.75
+	ROUTED TO	STOR1	7606.	7.50	5280.	2442.	817.	53.75
+	DIVERSION TO	DOCAP*	3714.	7.83	1718.	430.	143.	53.75
+	HYDROGRAPH AT	DCAP*	4040.	7.42	3563.	2013.	673.	53.75
+	DIVERSION TO	DOCP14	407.	7.42	352.	177.	59.	53.75
+	HYDROGRAPH AT	DCAP14	3633.	7.42	3211.	1836.	614.	53.75
+	DIVERSION TO	DOCP13	462.	7.42	409.	237.	81.	53.75
+	HYDROGRAPH AT	DCAP13	3170.	7.42	2802.	1598.	533.	53.75
+	DIVERSION TO	DOCP12	432.	7.42	398.	232.	78.	53.75
+	HYDROGRAPH AT	DCAP12	2738.	7.42	2404.	1366.	456.	53.75
+	DIVERSION TO	DOCP11	444.	7.42	414.	244.	81.	53.75
+	HYDROGRAPH AT	DCAP11	2294.	7.42	1989.	1123.	374.	53.75
+	DIVERSION TO	DOCP10	476.	7.42	410.	240.	80.	53.75
+	HYDROGRAPH AT	DCAP10	1818.	7.42	1579.	883.	294.	53.75
+	DIVERSION TO	DOCP09	487.	7.42	401.	231.	77.	53.75
+	HYDROGRAPH AT	DCAP09	1330.	7.42	1178.	651.	217.	53.75
+	DIVERSION TO	DOCP08	419.	7.50	395.	220.	73.	53.75
+	HYDROGRAPH AT	DCAP08	912.	7.42	784.	431.	144.	53.75
+	DIVERSION TO	DOCP07	445.	7.42	396.	219.	73.	53.75
+	HYDROGRAPH AT	DCAP07	466.	7.42	388.	212.	71.	53.75
+	DIVERSION TO	DOCPOT	35.	7.42	2.	0.	0.	53.75
+	HYDROGRAPH AT	DCAPOT	431.	7.42	387.	212.	71.	53.75
+	ROUTED TO	RWI542	421.	7.58	386.	212.	71.	53.75
+	HYDROGRAPH AT	WI529	338.	4.17	52.	13.	4.	.17
+	2 COMBINED AT	CWI529	834.	7.08	453.	246.	82.	4.13
+	DIVERSION TO	DO529	216.	7.08	23.	6.	2.	4.13
+	HYDROGRAPH AT	D529	618.	7.08	429.	240.	80.	4.13
+	ROUTED TO	RWI529	600.	7.33	429.	240.	80.	4.13
+	HYDROGRAPH AT	WI516	223.	4.17	36.	9.	3.	.14
+	3 COMBINED AT	CWI516	5253.	6.92	3362.	1074.	358.	23.64
	ROUTED TO							

+		RWI516	5001.	7.67	3336.	1074.	358.	23.64
+	HYDROGRAPH AT	WI512	1480.	4.42	372.	95.	32.	1.36
+	2 COMBINED AT	CWI512	4965.	7.67	3448.	1144.	382.	24.99
+	HYDROGRAPH AT	DCAP07	445.	7.42	396.	219.	73.	53.75
+	ROUTED TO	RDCP07	424.	7.83	395.	219.	73.	53.75
+	HYDROGRAPH AT	WI528	544.	4.25	109.	27.	9.	.36
+	HYDROGRAPH AT	D529	216.	7.08	23.	6.	2.	4.13
+	ROUTED TO	RD529	115.	7.50	23.	6.	2.	4.13
+	3 COMBINED AT	CWI528	985.	7.33	510.	276.	92.	3.41
+	ROUTED TO	RWI528	884.	7.75	507.	276.	92.	3.41
+	HYDROGRAPH AT	DCAPOT	35.	7.42	2.	0.	0.	53.75
+	ROUTED TO	RDCPOT	5.	8.08	2.	0.	0.	53.75
+	HYDROGRAPH AT	WI527	998.	4.33	202.	51.	17.	.71
+	2 COMBINED AT	CWI527	998.	4.33	315.	83.	28.	.71
+	DIVERSION TO	DO527	181.	4.33	18.	5.	2.	.71
+	HYDROGRAPH AT	D527	817.	4.33	296.	79.	26.	.71
+	ROUTED TO	RWI527	749.	4.67	295.	79.	26.	.71
+	HYDROGRAPH AT	WI518	803.	4.25	154.	39.	13.	.53
+	3 COMBINED AT	CWI518	1402.	4.67	769.	360.	121.	5.54
+	2 COMBINED AT	C508*	5217.	7.75	3907.	1431.	479.	30.53
+	ROUTED TO	R508*	5107.	8.33	3890.	1429.	479.	30.53
+	HYDROGRAPH AT	WI508	563.	4.50	142.	36.	12.	.70
+	2 COMBINED AT	CWI508	5092.	8.33	3918.	1448.	485.	31.23
+	DIVERSION TO	DO508	967.	8.33	744.	275.	92.	31.23
+	HYDROGRAPH AT	D508	4124.	8.33	3174.	1173.	393.	31.23
+	HYDROGRAPH AT	WI510A	1254.	4.33	254.	64.	21.	1.13
+	ROUTED TO	R510A	910.	5.42	251.	64.	21.	1.13
+	HYDROGRAPH AT	WI510	760.	4.75	270.	70.	23.	1.23
+	3 COMBINED AT	CWI510	4322.	8.25	3536.	1289.	432.	27.65
+	ROUTED TO	RWI510	4250.	8.67	3414.	1289.	432.	27.65
+	HYDROGRAPH AT	WI502	900.	4.67	278.	72.	24.	1.21
+	3 COMBINED AT	CWI502	15769.	8.25	14330.	5809.	1955.	204.48

+	ROUTED TO	RWI502	15765.	8.33	14324.	5809.	1955.	204.48
+	HYDROGRAPH AT	DCAP08	419.	7.50	395.	220.	73.	53.75
+	ROUTED TO	RDCP08	415.	7.67	394.	220.	73.	53.75
+	HYDROGRAPH AT	WI526	54.	4.25	12.	3.	1.	.05
+	2 COMBINED AT	CWI526	506.	7.17	420.	235.	78.	4.10
+	ROUTED TO	RWI526	486.	8.00	419.	235.	78.	4.10
+	HYDROGRAPH AT	WI525	1895.	4.42	443.	112.	37.	1.94
+	HYDROGRAPH AT	DCAP09	487.	7.42	401.	231.	77.	53.75
+	ROUTED TO	RDCP09	439.	8.25	400.	231.	77.	53.75
+	HYDROGRAPH AT	D527	181.	4.33	18.	5.	2.	.71
+	ROUTED TO	RD527	58.	5.00	18.	5.	2.	.71
+	4 COMBINED AT	CWI525	1778.	7.67	1115.	610.	205.	10.23
+	DIVERSION TO	DO525	92.	4.50	49.	22.	7.	10.23
+	HYDROGRAPH AT	D525	1420.	4.50	934.	555.	187.	10.23
+	ROUTED TO	RWI525	1279.	5.17	922.	554.	187.	10.23
+	HYDROGRAPH AT	WI524	987.	4.42	220.	56.	19.	.95
+	HYDROGRAPH AT	D525	92.	4.50	49.	22.	7.	10.23
+	ROUTED TO	RD525	72.	5.50	48.	22.	7.	10.23
+	2 COMBINED AT	CWI524	978.	4.42	274.	84.	28.	1.60
+	DIVERSION TO	DO524	44.	4.42	4.	1.	0.	1.60
+	HYDROGRAPH AT	D524	868.	4.42	260.	80.	27.	1.60
+	ROUTED TO	RWI524	802.	4.75	257.	80.	27.	1.60
+	HYDROGRAPH AT	WI506	1284.	4.58	345.	88.	29.	1.58
+	3 COMBINED AT	CWI506	2605.	5.00	1303.	685.	232.	12.67
+	ROUTED TO	RWI506	2474.	5.25	1297.	685.	232.	12.67
+	HYDROGRAPH AT	D508	967.	8.33	744.	275.	92.	31.23
+	ROUTED TO	RD508	957.	8.58	741.	275.	92.	31.23
+	HYDROGRAPH AT	WI500	972.	4.42	227.	57.	19.	1.05
+	4 COMBINED AT	CWI500	16395.	8.33	14999.	6309.	2124.	224.18
+	ROUTED TO	SSPILL	2117.	18.50	2100.	1903.	1366.	224.18
+	ROUTED TO	RWI500	2117.	19.08	2100.	1902.	1365.	224.18
+	HYDROGRAPH AT	PI635	807.	4.42	110.	27.	9.	.61

+	2 COMBINED AT	CPI635	2117.	19.08	2100.	1902.	1365.	224.79
+	ROUTED TO	RPI635	2114.	19.75	2097.	1900.	1364.	224.79
+	HYDROGRAPH AT	DCAP11	444.	7.42	414.	244.	81.	53.75
+	ROUTED TO	RDCP11	438.	7.75	414.	243.	81.	53.75
+	HYDROGRAPH AT	DCAP12	432.	7.42	398.	232.	78.	53.75
+	ROUTED TO	RDCP12	422.	7.75	398.	232.	78.	53.75
+	HYDROGRAPH AT	PI618	448.	4.17	58.	14.	5.	.29
+	3 COMBINED AT	CPI618	1064.	7.25	863.	509.	170.	8.63
+	DIVERSION TO	DO618	564.	7.25	457.	270.	90.	8.63
+	HYDROGRAPH AT	D618	500.	7.25	405.	239.	80.	8.63
+	ROUTED TO	RPI618	490.	8.00	405.	239.	80.	8.63
+	HYDROGRAPH AT	DCAP13	462.	7.42	409.	237.	81.	53.75
+	ROUTED TO	RDCP13	439.	8.08	409.	237.	81.	53.75
+	HYDROGRAPH AT	PI615	855.	4.33	154.	39.	13.	.84
+	HYDROGRAPH AT	D618	564.	7.25	457.	270.	90.	8.63
+	ROUTED TO	RD618	557.	7.67	457.	270.	90.	8.63
+	3 COMBINED AT	CPI615	1148.	7.67	904.	549.	186.	9.61
+	ROUTED TO	RPI615	1130.	7.92	904.	549.	186.	9.61
+	HYDROGRAPH AT	PI612	701.	4.42	165.	42.	14.	.74
+	3 COMBINED AT	CPI612	1431.	8.17	1292.	804.	272.	14.40
+	DIVERSION TO	DO612	1073.	8.17	969.	603.	204.	14.40
+	HYDROGRAPH AT	D612	358.	8.17	323.	201.	68.	14.40
+	ROUTED TO	RPI612	357.	8.42	323.	201.	68.	14.40
+	HYDROGRAPH AT	DCAP14	407.	7.42	352.	177.	59.	53.75
+	ROUTED TO	RDCP14	378.	8.67	351.	177.	59.	53.75
+	HYDROGRAPH AT	PI609	1233.	4.67	363.	93.	31.	1.94
+	3 COMBINED AT	CPI609	1291.	4.75	900.	475.	160.	9.15
+	ROUTED TO	RPI609	1277.	4.92	898.	475.	160.	9.15
+	HYDROGRAPH AT	PI600A	1179.	4.08	124.	31.	10.	.52
+	2 COMBINED AT	C600A	1403.	4.75	940.	497.	168.	9.67
+	DIVERSION TO	DO600A	1403.	4.75	940.	497.	168.	9.67
	HYDROGRAPH AT							

+	D600A	0.	.00	0.	0.	0.	9.67
+ HYDROGRAPH AT	PI621	907.	4.42	201.	51.	17.	.90
+ HYDROGRAPH AT	D612	1073.	8.17	969.	603.	204.	14.40
+ ROUTED TO	RD612	1058.	8.75	967.	603.	204.	14.40
+ 2 COMBINED AT	CPI621	1272.	5.25	1051.	646.	220.	11.70
+ ROUTED TO	SPI621	1270.	5.25	1050.	641.	216.	11.70
+ ROUTED TO	RPI621	1256.	5.42	1048.	641.	216.	11.70
+ HYDROGRAPH AT	DCAP10	476.	7.42	410.	240.	80.	53.75
+ ROUTED TO	RDCP10	451.	7.83	410.	240.	80.	53.75
+ HYDROGRAPH AT	PI628	953.	4.17	111.	28.	9.	.57
+ 2 COMBINED AT	CPI628	1057.	7.25	511.	291.	97.	4.75
+ ROUTED TO	RPI628	869.	8.17	506.	290.	97.	4.75
+ HYDROGRAPH AT	PI624A	1953.	4.67	560.	143.	48.	2.81
+ 2 COMBINED AT	C624A	2115.	4.75	906.	408.	138.	7.56
+ ROUTED TO	R624A	1824.	5.58	893.	408.	138.	7.56
+ HYDROGRAPH AT	PI639	273.	4.50	80.	21.	7.	.34
+ HYDROGRAPH AT	D524	44.	4.42	4.	1.	0.	1.60
+ ROUTED TO	RD524	25.	4.75	4.	1.	0.	1.60
+ 2 COMBINED AT	CPI639	310.	4.50	87.	22.	7.	.43
+ ROUTED TO	RPI639	241.	5.17	86.	22.	7.	.43
+ HYDROGRAPH AT	PI636	566.	4.25	102.	26.	9.	.43
+ 2 COMBINED AT	CPI636	566.	4.33	177.	46.	15.	.86
+ ROUTED TO	RPI636	562.	4.33	177.	46.	15.	.86
+ HYDROGRAPH AT	PI624	1157.	4.50	298.	76.	25.	1.23
+ 3 COMBINED AT	CPI624	2369.	5.50	1191.	501.	170.	9.64
+ ROUTED TO	SPI624	2358.	5.50	1184.	485.	163.	9.64
+ ROUTED TO	RPI624	2287.	5.83	1168.	484.	163.	9.64
+ HYDROGRAPH AT	PI633	411.	4.33	89.	23.	8.	.34
+ 5 COMBINED AT	CPI633	2833.	15.75	2744.	2298.	1553.	246.48
+ ROUTED TO	RPI633	2830.	16.33	2743.	2297.	1553.	246.48
+ HYDROGRAPH AT	PDEAST	8797.	5.25	2511.	640.	213.	16.44
+ HYDROGRAPH AT	DCAP*	3714.	7.83	1718.	430.	143.	53.75

+	2 COMBINED AT	CAP2*	8797.	5.25	4364.	1181.	394.	33.74
+	ROUTED TO	STOR2	3384.	8.75	3134.	1171.	390.	33.74
+	DIVERSION TO	DOCP19	1156.	8.75	1078.	425.	142.	33.74
+	HYDROGRAPH AT	DCAP19	2228.	8.75	2056.	746.	249.	33.74
+	DIVERSION TO	DOCP18	383.	8.83	355.	133.	44.	33.74
+	HYDROGRAPH AT	DCAP18	1845.	8.75	1701.	613.	204.	33.74
+	DIVERSION TO	DOCP17	379.	8.83	350.	129.	43.	33.74
+	HYDROGRAPH AT	DCAP17	1467.	8.75	1351.	484.	161.	33.74
+	DIVERSION TO	DOCP16	1139.	8.75	1054.	384.	128.	33.74
+	HYDROGRAPH AT	DCAP16	327.	8.75	297.	100.	33.	33.74
+	ROUTED TO	RDCP15	327.	9.17	297.	100.	33.	33.74
+	HYDROGRAPH AT	PI606A	546.	4.25	90.	23.	8.	.46
+	2 COMBINED AT	C606A	396.	9.50	361.	149.	50.	3.55
+	DIVERSION TO	DO606A	162.	9.50	148.	61.	20.	3.55
+	HYDROGRAPH AT	D606A	234.	9.50	213.	88.	29.	3.55
+	ROUTED TO	R606A	233.	10.00	213.	88.	29.	3.55
+	HYDROGRAPH AT	PI606	1033.	4.42	231.	58.	19.	1.08
+	2 COMBINED AT	CPI606	881.	4.58	359.	142.	47.	3.17
+	ROUTED TO	RPI606	830.	4.83	354.	142.	47.	3.17
+	HYDROGRAPH AT	PI604	494.	4.25	92.	23.	8.	.36
+	HYDROGRAPH AT	D606A	162.	9.50	148.	61.	20.	3.55
+	ROUTED TO	RD606A	162.	9.83	148.	61.	20.	3.55
+	2 COMBINED AT	CPI604	496.	4.50	204.	85.	28.	1.82
+	ROUTED TO	RPI604	462.	4.83	201.	85.	28.	1.82
+	HYDROGRAPH AT	PD744	709.	4.42	151.	38.	13.	.80
+	HYDROGRAPH AT	D600A	1403.	4.75	940.	497.	168.	9.67
+	ROUTED TO	RD600A	1236.	5.33	922.	497.	168.	9.67
+	HYDROGRAPH AT	PI603	633.	4.33	120.	30.	10.	.52
+	5 COMBINED AT	CPI603	2506.	4.92	1479.	725.	245.	15.98
+	ROUTED TO	SPI603	2386.	5.17	1475.	725.	245.	15.98
+	DIVERSION TO	DO744	0.	.00	0.	0.	0.	15.98
+	HYDROGRAPH AT	D744	2386.	5.17	1475.	725.	245.	15.98

ROUTED TO	RPI603	2340.	5.42	1461.	725.	245.	15.98
HYDROGRAPH AT	PI600	1007.	4.17	136.	34.	11.	.61
3 COMBINED AT	CPI600	3219.	15.08	3145.	2634.	1655.	263.07
ROUTED TO	RPI600	3214.	15.58	3145.	2630.	1655.	263.07
HYDROGRAPH AT	DCAP16	1139.	8.75	1054.	384.	128.	33.74
ROUTED TO	RDCP16	1138.	9.25	1052.	384.	128.	33.74
HYDROGRAPH AT	DCAP17	379.	8.83	350.	129.	43.	33.74
ROUTED TO	RDCP17	379.	9.08	349.	129.	43.	33.74
HYDROGRAPH AT	PD740	1005.	4.75	221.	56.	19.	1.28
3 COMBINED AT	CPD740	1698.	9.42	1560.	631.	210.	16.31
ROUTED TO	RPD740	1697.	9.75	1559.	631.	210.	16.31
HYDROGRAPH AT	PD726B	849.	4.67	173.	43.	14.	.93
2 COMBINED AT	C726B	1695.	9.75	1563.	660.	220.	17.24
ROUTED TO	R726B	1682.	9.92	1554.	655.	218.	17.24
HYDROGRAPH AT	DCAP18	383.	8.83	355.	133.	44.	33.74
ROUTED TO	RDCP18	383.	9.25	355.	133.	44.	33.74
HYDROGRAPH AT	PD736	358.	4.83	144.	37.	12.	.78
2 COMBINED AT	CPD736	489.	6.08	458.	194.	65.	4.64
ROUTED TO	RPD736	488.	6.17	458.	194.	65.	4.64
HYDROGRAPH AT	DCAP19	1156.	8.75	1078.	425.	142.	33.74
ROUTED TO	RDCP19	1156.	9.00	1077.	425.	142.	33.74
HYDROGRAPH AT	PD760	1464.	4.17	179.	45.	15.	.87
ROUTED TO	SCP200	410.	4.75	178.	45.	15.	.87
ROUTED TO	RPD760	408.	4.92	177.	45.	15.	.87
HYDROGRAPH AT	PD732	687.	4.42	98.	24.	8.	.48
3 COMBINED AT	CPD732	1319.	5.67	1235.	541.	180.	13.11
ROUTED TO	RPD732	1298.	6.33	1234.	541.	180.	13.11
HYDROGRAPH AT	PD726A	579.	4.75	203.	52.	17.	1.10
3 COMBINED AT	C726A	1909.	6.17	1704.	730.	244.	18.85
ROUTED TO	R726A	1902.	6.33	1702.	730.	244.	18.85
2 COMBINED AT	C726*	3211.	6.58	3005.	1212.	404.	36.10
ROUTED TO							

+	R726*	3130.	7.25	2973.	1211.	404.	36.10
+ HYDROGRAPH AT	PD726	1051.	4.42	240.	60.	20.	1.35
+ HYDROGRAPH AT	PD716	2642.	4.17	356.	89.	30.	1.75
+ 3 COMBINED AT	CPD726	3146.	7.17	2971.	1298.	434.	39.20
+ ROUTED TO	SPD726	3136.	7.25	2944.	1287.	430.	39.20
+ DIVERSION TO	DO716	701.	7.25	549.	156.	52.	39.20
+ HYDROGRAPH AT	D716	2435.	7.25	2396.	1131.	378.	39.20
+ ROUTED TO	RPD726	2432.	7.58	2394.	1131.	378.	39.20
+ HYDROGRAPH AT	PD720	944.	4.25	130.	33.	11.	.59
+ HYDROGRAPH AT	D744	0.	.00	0.	0.	0.	15.98
+ ROUTED TO	RD744	0.	.00	0.	0.	0.	15.98
+ 4 COMBINED AT	CPD720	5207.	8.58	4859.	3206.	1817.	296.13
+ ROUTED TO	RPD720	5206.	8.67	4859.	3206.	1817.	296.13
+ HYDROGRAPH AT	D716	701.	7.25	549.	156.	52.	39.20
+ ROUTED TO	RD716	699.	7.50	547.	156.	52.	39.20
+ 2 COMBINED AT	C700*	5569.	8.25	4990.	3222.	1817.	302.88
+ ROUTED TO	R700*	5495.	8.92	4960.	3212.	1812.	302.88
+ HYDROGRAPH AT	PD752	356.	4.17	47.	12.	4.	.19
+ HYDROGRAPH AT	PD748	559.	4.17	72.	18.	6.	.28
+ 2 COMBINED AT	CPD748	914.	4.17	119.	30.	10.	.47
+ ROUTED TO	SCP220	533.	4.42	119.	30.	10.	.47
+ ROUTED TO	RPD748	525.	4.75	118.	30.	10.	.47
+ HYDROGRAPH AT	PD756	1791.	4.83	663.	174.	58.	3.23
+ ROUTED TO	SCP210	1778.	4.92	663.	174.	58.	3.23
+ ROUTED TO	RPD756	1746.	5.25	663.	174.	58.	3.23
+ 2 COMBINED AT	C708*	2010.	5.00	755.	198.	66.	3.70
+ ROUTED TO	R708*	1956.	5.42	754.	198.	66.	3.70
+ HYDROGRAPH AT	PD708	1829.	4.58	466.	118.	39.	2.40
+ HYDROGRAPH AT	PD712A	546.	4.58	162.	41.	14.	.77
+ ROUTED TO	R712A	535.	4.92	162.	41.	14.	.77
+ HYDROGRAPH AT	PD712	987.	4.67	198.	50.	17.	.89
+ 4 COMBINED AT	CPD708	3529.	5.08	1401.	368.	123.	7.76

+	ROUTED TO	RPD708	3489.	5.17	1400.	368.	123.	7.76
+	HYDROGRAPH AT	PD704	491.	4.25	77.	19.	6.	.36
+	HYDROGRAPH AT	AF800	952.	4.25	168.	42.	14.	.72
+	3 COMBINED AT	CPD704	3804.	5.08	1574.	414.	138.	8.84
+	ROUTED TO	SPD704	3708.	5.25	1574.	414.	138.	8.84
+	DIVERSION TO	DO800	0.	.00	0.	0.	0.	8.84
+	HYDROGRAPH AT	D800	3708.	5.25	1574.	414.	138.	8.84
+	ROUTED TO	RPD704	3676.	5.50	1573.	414.	138.	8.84
+	HYDROGRAPH AT	PD700	1683.	4.33	274.	69.	23.	1.40
+	3 COMBINED AT	CPD700	5673.	8.75	5104.	3313.	1845.	313.12
+	HYDROGRAPH AT	D800	0.	.00	0.	0.	0.	8.84
+	ROUTED TO	RD800	0.	.00	0.	0.	0.	8.84
+	HYDROGRAPH AT	AF802	671.	4.25	105.	26.	9.	.39
+	3 COMBINED AT	C802*	5672.	8.75	5103.	3316.	1847.	313.51
+	ROUTED TO	R810*	5655.	9.25	5098.	3313.	1845.	313.51
+	HYDROGRAPH AT	AF803	2004.	4.67	547.	139.	46.	2.84
+	ROUTED TO	RAF803	1935.	4.83	545.	139.	46.	2.84
+	HYDROGRAPH AT	AF805	805.	4.33	137.	34.	11.	.63
+	ROUTED TO	RAF805	639.	5.08	137.	34.	11.	.63
+	HYDROGRAPH AT	AF807	1935.	4.17	261.	65.	22.	1.02
+	3 COMBINED AT	CAF807	2905.	4.67	873.	224.	75.	4.49
+	ROUTED TO	RAF807	2887.	4.67	873.	224.	75.	4.49
+	HYDROGRAPH AT	AF810	1020.	4.58	508.	130.	43.	2.12
+	3 COMBINED AT	CAF810	5664.	9.17	5101.	3365.	1867.	320.12
+	ROUTED TO	RAF810	5650.	9.50	5095.	3363.	1866.	320.12
+	HYDROGRAPH AT	AF820	584.	4.42	132.	33.	11.	.70
+	2 COMBINED AT	CAF820	5648.	9.50	5093.	3364.	1866.	320.81
+	HYDROGRAPH AT	AF830	349.	4.25	66.	17.	6.	.27
+	HYDROGRAPH AT	AF854	866.	4.08	90.	23.	8.	.34
+	ROUTED TO	RAF854	796.	4.17	90.	23.	8.	.34
+	HYDROGRAPH AT	AF852	481.	4.08	47.	12.	4.	.17
+	2 COMBINED AT	CAF852	1179.	4.08	137.	34.	11.	.51

+	ROUTED TO RAF852	1172.	4.17	137.	34.	11.	.51
+	HYDROGRAPH AT AF850	633.	4.08	71.	18.	6.	.22
+	2 COMBINED AT CAF850	1596.	4.17	205.	52.	17.	.72
+	HYDROGRAPH AT AF864	108.	4.25	22.	5.	2.	.09
+	ROUTED TO RAF864	67.	4.67	21.	5.	2.	.09
+	HYDROGRAPH AT AF862	533.	4.00	35.	9.	3.	.18
+	2 COMBINED AT CAF862	543.	4.00	55.	14.	5.	.26
+	ROUTED TO RAF862	441.	4.08	55.	14.	5.	.26
+	HYDROGRAPH AT AF866	912.	4.17	132.	33.	11.	.45
+	ROUTED TO RAF866	634.	4.42	129.	33.	11.	.45
+	HYDROGRAPH AT AF860	543.	4.25	106.	27.	9.	.36
+	3 COMBINED AT CAF860	1226.	4.25	278.	72.	24.	1.08
+	HYDROGRAPH AT SV258	1018.	4.42	197.	50.	17.	.74
+	DIVERSION TO DO258	499.	4.42	96.	24.	8.	.74
+	HYDROGRAPH AT D258	519.	4.42	100.	25.	8.	.74
+	ROUTED TO RSV258	487.	4.58	100.	25.	8.	.74
+	HYDROGRAPH AT SV256	121.	4.08	15.	4.	1.	.06
+	2 COMBINED AT CSV256	564.	4.50	116.	29.	10.	.44

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION SSPILL
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1354.13	.00	21958.	8323.	.00	14.75	.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1354.08	.00	21857.	7969.	.00	14.92	.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1353.59	.00	20649.	4313.	.00	16.75	.00

PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1352.59	.00	17763.	4099.	.00	16.83	.00

PLAN 5 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.19	.00	13802.	3072.	.00	17.67	.00

PLAN 6 .....

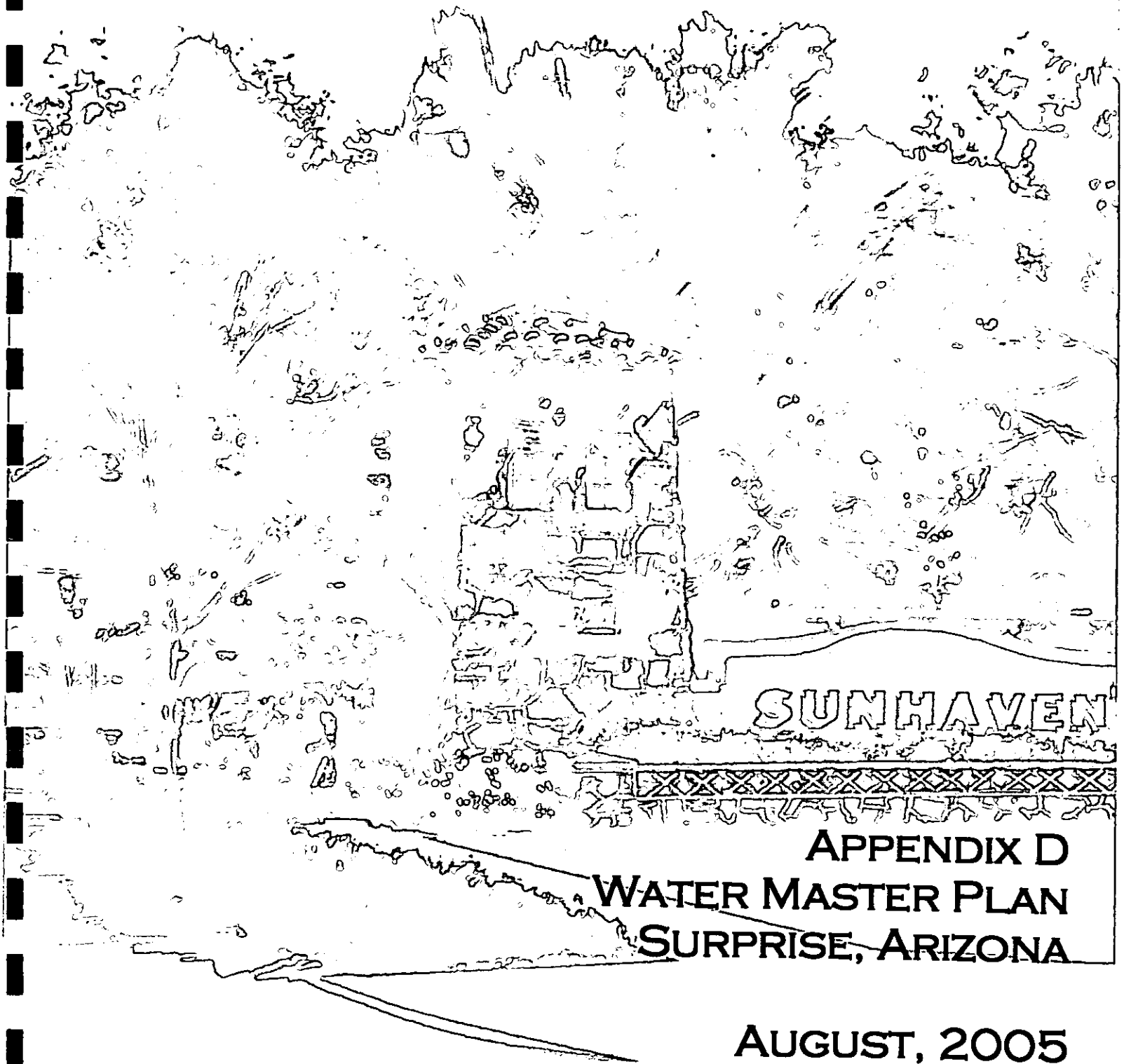
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1346.09	.00	7256.	1287.	.00	19.58	.00

*** NORMAL END OF HEC-1 ***

SUNHAVEN - PAD

A MASTER PLANNED COMMUNITY



APPENDIX D
WATER MASTER PLAN
SURPRISE, ARIZONA

AUGUST, 2005

REVISED SUBMITTAL – DECEMBER, 2005

Concept Water Master Plan
For
SUNHAVEN

Surprise, Arizona

Prepared for

Sunhaven I, LLC
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Phoenix, AZ 85008

602-286-0000

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December 14, 2005

RECEIVED
DEC 21 2005
COMMUNITY DEVELOPMENT

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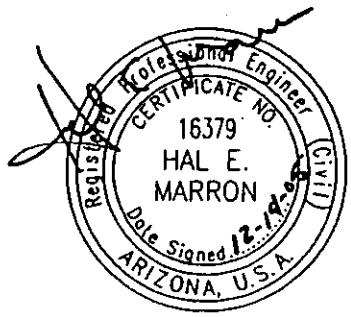


Sunhaven
Concept Water Master Plan

1.0 EXECUTIVE SUMMARY

Sunhaven consists of approximately 2,120 acres of a proposed Planned Area Development. Sunhaven is located in the planning area of the City of Surprise in the northwest portion of the Phoenix Metropolitan area of Maricopa County. It is the intent of the owner to request annexation into the City of Surprise prior to the approval of the Planned Area Development action by the City. The project is located in portions of Sections 17, 19, 20, and 21, Township 5 North, Range 2 West of the Gila-Salt River Base and Meridian. The property lies north of the Central Arizona Project Canal and east of Highway 60.

This report has been prepared to aid with the master planning of the project. It is expected that this report will be adjusted over time to reflect the changes in planning concepts that may occur during the master planning process.

The majority of property lies within the future service area of the City of Surprise. A portion of the project lies within the service area of West End Water. Neither service area has any constructed facilities in this area. For the purposes of this report two water service systems, one within the service area of each provider, have been analyzed to serve Sunhaven. While this approach disagrees with the City's Water Master Plan for Special Planning Area 4, it does follow State law related to water service areas. Negotiations and agreement with West End Water Company would be required for the City to provide service west of 203rd from a City of Surprise water system.

A City of Surprise water system will be designed and constructed to serve the needs of 8,001 units for the portion of Sunhaven within the City's water service area. The water demand per capita consumption rate of 160 gallons per day has been used as a basis for sizing the system. Based upon a population estimate of 3.2 capita for low density residential dwelling units and 2.0 capita for medium/high density residential units for each of the expected 8,001 residential units, a total population of 21,722 is expected. In addition, a water demand value of 2,500 gallons per day was estimated for each acre of proposed commercial and employment development. This density of dwelling units over the property is based upon the City of Surprise General Plan for the area and the levels proposed by the developer within the Sunhaven Master Planned Community Planned Area Development document. The facilities will be sized based upon the greater of the peak hour flow or the maximum day plus fire flow amount.

The City water system for the Sunhaven project has been designed based upon supply from wells that will be constructed on the property. The property lies within Zones 8 and 9 of the City of Surprise's Water system. Currently no water facilities exist within or around the project.

The City of Surprise guidelines require the construction of a minimum of two 1500 gallon per minute wells for each section of land included in the development. Based upon these criterion 6 wells would be required for the City portion of Sunhaven. Well service requirements for this project have been estimated based upon meeting average day maximum month (1.7 times ADD) with one well in reserve. The wells will be collected in a series of pipelines that will convey the water to the water plant.

Due to the planned reduction in the federal allowable standard for arsenic content in drinking water from 30 to 10 parts per billion, it should be expected that the well water may need to be treated. As the wells are developed, the level of Arsenic, as well as other water quality elements, will be tested. The City of Surprise is currently reviewing arsenic treatment processes to be included within their plants, if required, before the water is stored in the above ground steel reservoirs and delivered to the customers.

The City has established preliminary hydraulic grade lines of 1,730 and 1810, for zones 8 and 9 respectively. Based upon our analysis and the placement of the zones in relation to the Central Arizona Project Canal, we would recommend adjustment of these zone gradelines to 1,760 and 1,820 respectively. For the purpose of this report, similar pressure zones will be used in the West End Water Company Service area.

Any units where the static pressure exceeds 80 psi will be required to install an individual Pressure Reducing Valve (PRVs) on the service to that unit.

A computer model of the proposed City water system has been prepared using the EPANET 2.0 Model from the Environmental Protection Agency. The computer program evaluates the proposed water system network to simulate the expected performance of a water system under a variety of flow demand conditions. The following scenarios have been analyzed.

- Average Day Demands
- Maximum Day Demands
- Maximum Day Demand with a Coincident Fire Flow applied at various locations in the system.
- Peak Hour

The greater of the Peak Hour demand or the maximum day demand plus fire flow will govern the design of the Sunhaven water system. It should be noted that the Maximum Day plus commercial fire demand will govern the system size for Sunhaven. As noted in Table 1, the Peak Hour demands for the Sunhaven development within the City's service area are shown as 8,740 gallons per minute (12.6 MGD). Minimum fire flow demand of 1,200 gallons per minute will be used at any one location to size the system. Areas where homes will exceed 3,600 square feet in size will be evaluated using 1,750 gallons per minute for the fire flow demand. A 3,000 gallon per minute fire flow will be used to evaluate commercial, employment and other non-single family residential areas. The Maximum Day plus commercial fire demand is estimated at 8,827 gallons per minute.

2.0 INTRODUCTION

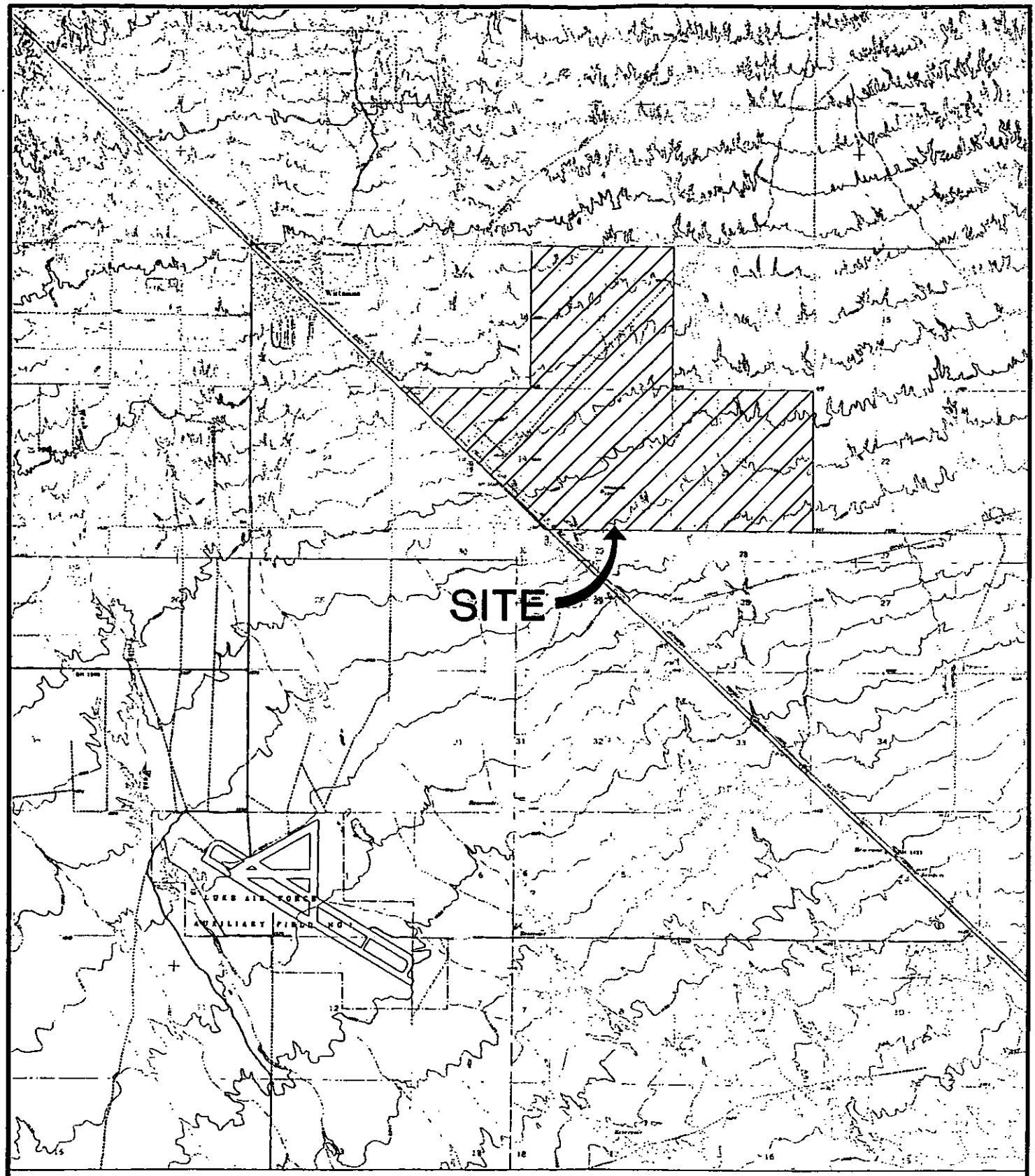
Sunhaven consists of approximately 2,120 acres of a proposed Planned Area Development. A total of approximately 1,903 acres lies within the City of Surprise water service area while the remaining 217 acres lies within the service area of West End Water Company. Sunhaven is located in the planning area of the City of Surprise in the northwest portion of the Phoenix Metropolitan area of Maricopa County. It is the intent of the owner to request annexation into the City of Surprise prior to the approval of the Planned Area Development action by the City. The project is located in portions of Sections 17, 19, 20, and 21, Township 5 North, Range 2 West of the Gila-Salt River Base and Meridian. The property lies north of the Central Arizona Project Canal and east of Highway 60. Please refer to the Vicinity map **(FIGURE 1)**.

This report has been prepared to aid with the master planning of the project. It is expected that this report will be adjusted over time to reflect the changes in planning concepts that may occur during the master planning process.

A portion of the property lies within the future water service area of the City of Surprise. A portion of the project lies within the service area of West End Water Company. The areas west of 203rd Avenue are within the West End Water Company service area. The entire project is shown with future City of Surprise water system improvements in the City of Surprise Water Infrastructure Master Plan. For the purposes of this report two water service systems, one within the service area of each provider, have been analyzed to serve Sunhaven. While this approach disagrees with the City's Water Master Plan for Special Planning Area 4, it does follow State law related to water service areas. Negotiations and agreement with West End Water Company would be required for the City to provide service west of 203rd from a City of Surprise water system.

The development, upon completion, will be accessed from 203rd Avenue and eventually from the future extension of Dove Valley Road, 195th Avenue, Tillman Drive, and 187th Avenue.

A City of Surprise water system will be designed and constructed to serve the needs of 8,001 units for Sunhaven. The water demand per capita consumption rate of 160 gallons per day has been used as a basis for sizing the system. Based upon a population estimate of 3.2 capita for low density residential dwelling units and 2.0 capita for medium/high density residential units for each of the expected 8,001 residential units, a total population of 21,722 is expected. In addition, a water demand value of 2,500 gallons per day was estimated for each acre of proposed commercial and employment development. This density of dwelling units over the property is based upon the City of Surprise General Plan for the area and the levels proposed by the developer with the Sunhaven Master Planned Community Planned Area Development document. The facilities will be sized based upon the greater of the peak hour flow or the maximum day plus fire flow amount.



MAP REFERENCES:

7.5 MINUTE QUADRANGLE MAP
WHITE TANKS MTS. NE., ARIZ.
PHOTOREVISED 1971

7.5 MINUTE QUADRANGLE MAP
WITTMANN., ARIZ.
PHOTOREVISED 1981

7.5 MINUTE QUADRANGLE MAP
HIEROGLYPHIC MTS. SW., ARIZ.
PHOTOREVISED 1981

7.5 MINUTE QUADRANGLE MAP
MCMICKEN DAM, ARIZ.
PHOTOREVISED 1981

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SUNHAVEN
- VICINITY MAP

FIGURE 1

DATE: 05/10/05 | PROJ. NO: 04043 | SCALE: 1"=5000' | CAD FILE: 04043V01

The water system for the SUNHAVEN project has been designed based upon supply from wells that will be constructed on the property. The City of Surprise guidelines require the construction of a minimum of two 1500 gallon per minute wells for each section of land included in the development. Well service requirements for this project have been estimated based upon meeting average day maximum month (1.7 times ADD) with one well in reserve and the maximum day demand with all wells producing and no support from the on-site reservoirs. The wells will be collected in a series of pipelines that will convey the water to the water plant.

Scope of Work

The purpose of this Water Master Plan is to study and determine the water distribution system requirements for the proposed Sunhaven (2,120-acre) development. Both City of Surprise and West End Water Company service areas will be discussed. This report has been prepared to aid with the master planning of the project. It is expected that this report will be adjusted over time to reflect the changes in planning concepts that may occur during the master planning. The water system will be designed to meet the guidelines established by the City of Surprise, Maricopa County, and the Arizona Department of Environmental Quality. The water system(s) and its designed components will be submitted to agencies of Maricopa County and the City of Surprise for review and approval at various stages of the development process.

The concept proposed for the City of Surprise Service Area is a stand-alone system designed such that it will be compatible with future adjacent facilities proposed for Special Planning Area 4. The City of Surprise pressure zone preferences are reviewed and commented on in this report.

Design Population

TABLE 1 lists the planned development areas (**FIGURE 2**) and expected number of units for Sunhaven. An allowance of 2,500 gallons per acre per day Average Day Demand has been included for the commercial / employment areas. These areas have been converted to Equivalent Dwelling Units (EDU's) based upon 512 gallons per EDU per day. The table also includes the expected population, water consumption, and expected peak flow demands. Based upon a population estimate of 3.2 capita per dwelling unit for each of the expected low and suburban density residential units and a population estimate of 2.0 capita per dwelling unit for the medium and high density residential units, a total population of approximately 21,722 is expected for Sunhaven. The Planning Documents for the Planned Area development have been used as the basis for the population distribution and land uses on the property.

Topographic Conditions

The property is undeveloped and appears to have been used for ranching in the past. Native desert vegetation covers the site. The natural slope of the land is from north to south at approximately 1.0 percent. The Atchison Topeka and Santa Fe Railroad right of

way forms the southwest boundary of the property. The slope along this right of way is from the northwest to the southeast at approximately 0.75 percent.

The high point on the Sunhaven property is approximately elevation 1695 at the northwest corner. And the lowest point of the property is elevation 1550 at the southeastern corner of the property. This represents an average slope of 0.95 percent across the property.

3.0 WATER FACILITIES

The subject property lies within Special Planning Area 4 (SPA4) of the City of Surprise water service area and the service area of the West End Water Company. The COS water system for the Sunhaven portion of the project has been designed based upon supply from wells that will be constructed on the property. The property lies within future Zones 8 and 9 of the City of Surprise Water system.

The City of Surprise service area Sunhaven facilities will include:

- Water Production Wells – The City of Surprise requires 2 wells with a capacity of 1500 gpm each. While it is the City of Surprise's desire to have 3,000 gallons per minute of water produced from each square mile of the project, it may not be possible. Approximately three square miles of the project lies within the City of Surprise service area (6 wells) while the remaining half square mile lies within the West End Water Company service area. The area of the project within the West End Water Service Area will be handled separately with that Company.

  The following criteria are provided to establish a basis for the minimum well development standards to be used for this project.

  - The developer will provide the 2 wells per section within the City's service area as required by the City of Surprise.

  - Each of the wells will be developed to the maximum safe yield that is determined during the well development. While it is the hope of the developer that 1,500 gallons per minute can be delivered from each of the wells, preliminary hydro-geology and a well developed on the site indicates that the potential safe yield from wells on this site may be less.

  - Due to separation requirements of potable water wells and draw down concerns, the addition of wells on the property must be carefully planned. Our discussions with a hydro-geologist familiar with the area has given us a belief that certain areas of the project will have significantly better yields than others, but spacing of the wells will need to be maintained for maximum well yield and recovery.

  - In addition to the six (6) wells, the developer will provide the water needs of the project based on the average day, maximum month criteria with redundancy. This criterion is proposed to establish minimum criteria for well production of the site.

The project needs within the City of Surprise Service area for the Average Day maximum month is estimated at 4,953 gpm. This criterion also allows for maximum day demand for Sunhaven (5,827 gpm) to be met will all wells producing and zero support from the system's storage reservoirs.

- This report has been based upon the wells not being able to deliver production water at this level. It has been determined that the required 6 wells, with a minimum of 990 gallons per minute of production each, will be sufficient to service the property. This allows for 5 wells to be in operation to meet the Average Day Maximum Month demand (1.7 times Average Day Demand) with one well in reserve. 1,000 gallons per minute for all wells has been used in the sizing of the well line facilities. As the locations of the wells have yet to be determined this was deemed as a conservative estimate for the sizing of the well lines.

- A well line that will deliver the collected flows from the seven wells to the water plant site. This delivery line will range from 8-inch diameter pipes at the well head to 20-inch diameter pipe.

- A potential treatment system for Arsenic removal. It is possible that the EPA's reduction of the Maximum Contaminant Level (MCL) of Arsenic in drinking water from 30 parts per billion to 10 parts per billion (ppb) will necessitate treatment. The City of Surprise requires water to meet a standard that does not exceed 70 percent of the MCL. Therefore the developed water could not exceed 7 ppb.

- Storage reservoir - The City of Surprise requires 1.2 million gallons of storage for each section of land. The IWMP cites a criterion that uses the Average day demand not depleting more than 80 percent of the storage. Both the IWMP and City of Surprise Code methods for determining the storage volume requested for the Sunhaven Development have been reviewed. Based upon the Sun Haven Area (not including the portion within the West Side Water Company service area) a total of 3.57 MG of storage would be required based upon the current City code while the IWMP method would require 5.24 MG. There are concerns with potential water quality issues that may occur with excess water storage that can not be used on a regular basis. It is the desire of this master plan to size the storage appropriately for the intended use.

  As a check, these volume requirements were compared using other calculation methods including Arizona American Water Company, AAWC Agua Fria Master Plan Criteria, ADEQ Bulletin 10 Criteria, and City of Scottsdale Criteria. These methods yield storage requirements that range from 2.6 MG to 4.9 MG. Based upon a review of these methods and the intent of the IWMP we recommend the following:

  - 3.6 MG storage is proposed. This represents a median of the methods reviewed and is consistent with current City of Surprise code.

- One of the wells required for water production will be drilled on the water campus site and be tied into the emergency backup power system for the site.

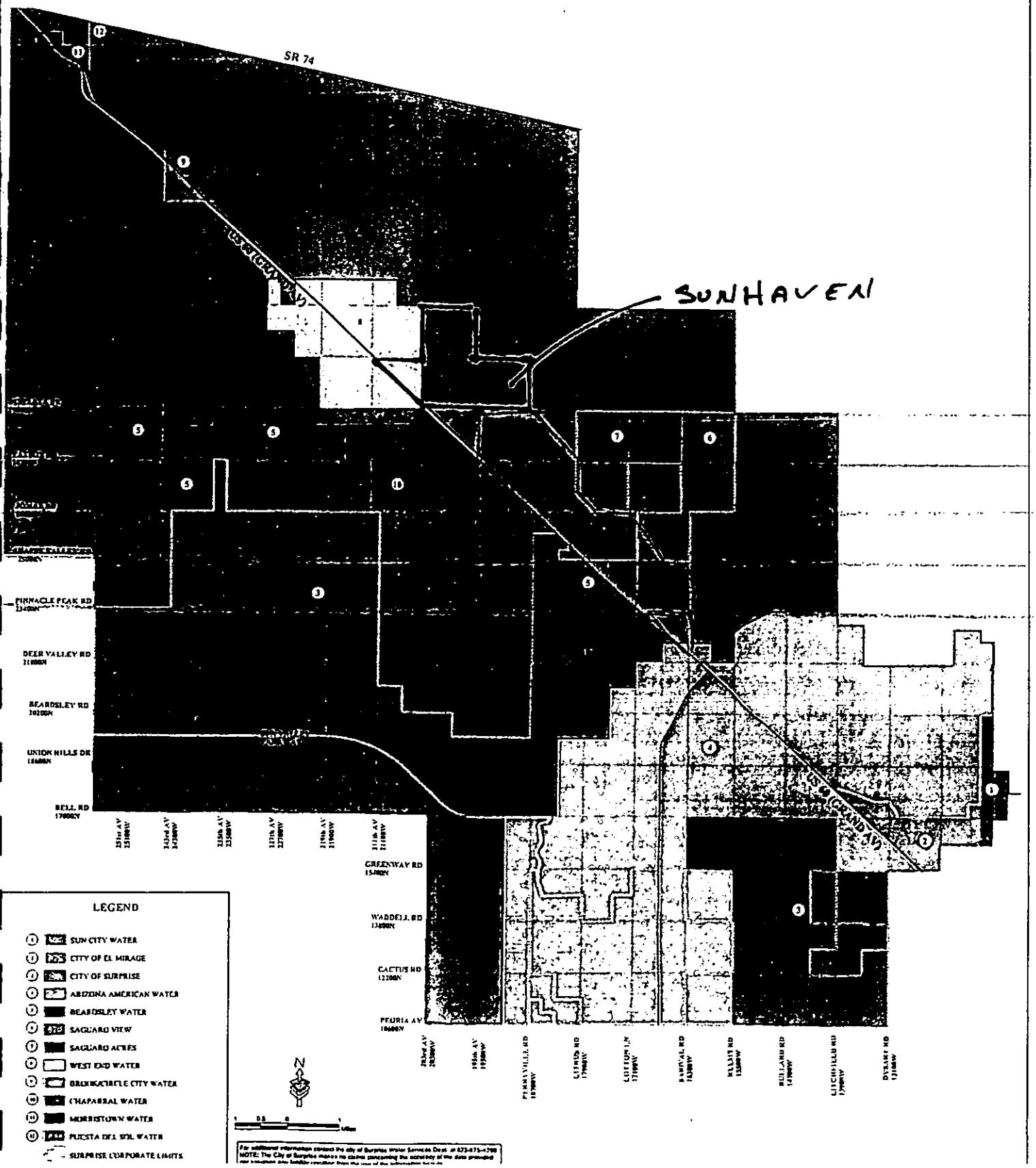
The addition of a well with backup power is described in Bulletin 10 and will allow for the reduction in the Average Daily Demand depletion. When the estimated safe yield for 90 percent of an anticipated Sun Haven Well of 900 gpm is applied to the ADD within IWMP criteria a storage requirement of 3.80 MG is obtained. In addition, when a factor of depletion of 87.5 percent rather than 80 percent is applied to the reservoir sizing, a volume of 3.48 MG is required. The 87.5 percentage represents 2 feet of a 16 foot tank being unusable storage.

- A Zone 8 and a Zone 9 booster pump station capable of delivering a firm capacity equal to the maximum day plus commercial fire flow rate for each zone. The firm capacity of a pump station is the capacity of the station with the largest pump out of service. We estimate the total firm capacity requirement to be 5,446 and 6,381 gallons per minute to service zones 8 and 9, respectively, in the Sunhaven development.

- Delivery lines necessary to distribute the flows. The water mains that are included in this report range from 24-inch mains leaving the plant to 12-inch lines. Local distribution mains will vary. The City of Surprise allows a minimum size main of 8-inches in diameter.

WATER PROVIDERS for CITY of SURPRISE GENERAL PLAN AREA

SURPRISE
ARIZONA



4.0 WATER DEMANDS

The distribution system was sized to deliver the greater of the maximum day plus fire flow demand or the peak hour demand. The Maximum Day plus commercial Fire Demand of 8,827 gallons per minute demand is more than the Peak Hour Flow Demand of 8,740 gallons per minute. The following factors were used to calculate the peak system flows:

Individuals per Dwelling Unit	3.2 Capita per D.U.
Average Water Use	160 gallons per capita per day
Maximum Day Peaking Factor	2.0 times Average Day
Peak Hour Peaking Factor	3.0 times Average Day
Residential Fire Flow	1,750 gallons per minute
Commercial Property Fire Flow	3,000 gallons per minute

A flow equal to 2,500 gallons per acre per day was included for the commercial / employment property within the development area. The Park facilities were estimated based on 500 gallons per acre per day for the recreational areas that will be irrigated with reclaimed water. The schools were estimated using 1200 students at 75 gallons per day. The same peaking factors will be used as in the residential developments.

When completed it is expected that Sunhaven will have the following total demands within the City of Surprise service area:

Average Day	2,913 gpm	4.2 MGD
Maximum Day	5,827 gpm	8.4 MGD
Maximum Day plus commercial fire flow	8,827 gpm	12.7 MGD
Peak Hour	8,740 gpm	12.6 MGD

The expected water demands for both the City of Surprise and West End Water Company portions of Sunhaven presented in **TABLE 1.**

7-Dec-05

TABLE 1
Water System Demands
West End Water Service Area Separated

Area	Land Use	Gross Area[Ac]	Net Area[Ac]	Density [Du/Ac]	Target Total Density Units	EDU's	Population	Unit Demand (gpcd)	Average Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Peak Hour Demand (gpd)	Peak Hour Demand (gpm)	Assigned
Phase 1															
A1	COMM	45.5	35.8	-	-	222	-	2500	113,811	79.0	227,622	158.1	341,434	237.1	16
A2	HDR	45.3	28.2	15-21	424	265	847	160	135,581	94.2	271,162	188.3	406,743	282.5	17
A3	LDR	41.7	32.6	3-5	187	187	600	160	95,981	66.7	191,961	133.3	287,942	200.0	10
A4	PARK	2.0	1.8	3-5	0	2	-	500	999	0.7	1,998	1.4	2,997	2.1	4
A5	LDR	24.7	19.4	3-5	111	111	356	160	56,975	39.6	113,950	79.1	170,928	118.7	17
A6	LDR	24.3	19.7	3-5	79	79	253	160	40,438	28.1	80,876	56.2	121,314	84.2	9
A7	PARK	3.4	2.2	3-5	0	3	-	500	1,705	1.2	3,409	2.4	5,114	3.6	9
A8	LDR	12.1	9.4	3-5	45	45	145	160	23,183	16.1	46,366	32.2	69,550	48.3	9
A9	LDR	47.9	30.7	3-5	144	144	460	160	73,624	51.1	147,248	102.3	220,873	153.4	11
A10	PARK	43.1	36.5	3-5	0	42	-	500	21,555	15.0	43,111	29.9	64,666	44.9	12
A11	LDR	27.1	20.5	3-5	88	88	282	160	45,144	31.4	90,289	62.7	135,433	94.1	3
A12	LDR	28.6	24.3	3-5	100	100	320	160	51,262	35.6	102,524	71.2	153,786	106.8	9
A13	LDR	39.0	33.0	3-5	140	140	449	160	71,858	49.9	143,716	99.8	215,573	149.7	4
A14	LDR	21.5	14.5	3-5	65	65	207	160	33,083	23.0	66,165	45.9	99,248	68.9	9
A15	LDR	29.0	25.3	3-5	87	87	278	160	44,524	30.9	89,049	61.8	133,573	92.8	4
A16	PARK	2.0	1.8	3-5	0	2	-	500	999	0.7	1,998	1.4	2,997	2.1	4
A17	LDR	18.2	14.3	3-5	77	77	248	160	39,672	27.6	79,345	55.1	119,017	82.7	4
A18	LDR	18.2	14.0	3-5	68	68	218	160	34,958	24.3	69,915	48.6	104,873	72.8	4
A19	PARK	2.0	1.9	3-5	0	2	-	500	999	0.7	1,998	1.4	2,997	2.1	3
A20	LDR	22.8	15.7	3-5	69	69	219	160	35,086	24.4	70,172	48.7	105,258	73.1	3
A21	LDR	30.8	24.9	3-5	92	92	296	160	47,289	32.8	94,577	65.7	141,866	98.5	3
A22	LDR	40.4	32.3	3-5	151	151	485	160	77,544	53.8	155,088	107.7	232,631	161.5	5, 15
A23	LDR	32.2	25.7	3-5	97	97	309	160	49,444	34.3	98,889	68.7	148,333	103.0	5
A24	LDR	29.1	23.5	3-5	90	90	289	160	46,179	32.1	92,358	64.1	138,536	96.2	30
A25	LDR	27.6	17.9	3-5	83	83	265	160	42,327	29.4	84,654	58.8	126,982	88.2	30
A26	LDR	20.7	16.1	3-5	62	62	199	160	31,790	22.1	63,581	44.2	95,371	66.2	4
A27	LDR	35.9	27.5	1-3	75	75	241	160	38,581	26.8	77,162	53.6	115,742	80.4	30
A28	LDR	26.6	21.6	3-5	109	109	349	160	55,848	38.8	111,695	77.6	167,543	116.3	32
A29	PARK	2.0	1.5	3-5	0	2	-	500	999	0.7	1,998	1.4	2,997	2.1	8
A30	LDR	27.7	22.2	3-5	104	104	332	160	53,099	36.9	106,199	73.7	159,298	110.6	8
A31	LDR	32.9	26.9	3-5	99	99	316	160	50,531	35.1	101,062	70.2	151,593	105.3	30
A32	SCHOOL	15.9	11.5	3-5	1200	176	-	75	90,000	62.5	180,000	125.0	270,000	187.5	30
A33	LDR	48.9	41.3	1-3	134	134	430	160	68,833	47.8	137,666	95.6	206,499	143.4	8
A34	PARK	2.0	1.7	3-5	0	2	-	500	999	0.7	1,998	1.4	2,997	2.1	30
A35	LDR	38.3	32.0	1-3	115	115	368	160	58,829	40.9	117,657	81.7	176,486	122.6	5
A36	LDR	38.2	32.3	3-5	157	157	502	160	80,244	55.7	160,488	111.4	240,732	167.2	6
A37	COMM	18.8	14.0	-	-	92	-	2500	46,990	32.6	93,981	65.3	140,971	97.9	6
Phase 1	TOTAL	966.4	754.6		3,053	3,439	9,262		1,760,964	1,222.9	3,521,927	2,445.8	5,282,891	3,668.7	

Wells at 1.7 ADD 2,079 gpm
Average Day Maximum Month

Area	Land Use	Gross Area[Ac]	Net Area[Ac]	Density [Du/Ac]	Target Total Density Units	EDU's	Population	Unit Demand (gpcd)	Average Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Peak Hour Demand (gpd)	Peak Hour Demand (gpm)	Assigned
Phase 2															
B4	Comm (1/2 COS)	37.8	31.0	-	-	185	-	2500	94,553	65.7	189,106	131.3	283,660	197.0	16
B5	HDR	25.9	22.6	5-8	466	291	932	160	149,120	103.6	298,240	207.1	447,360	310.7	38
B6	PARK	3.9	3.2		-	4	-	500	1,950	1.4	3,900	2.7	5,850	4.1	39
B7	SCHOOL	13.4	12.3		1200	176	-	75	90,000	62.5	180,000	125.0	270,000	187.5	34
B8	LDR	35.4	32.7	3-5	141	141	452	160	72,315	50.2	144,630	100.4	216,945	150.7	19
B9	LDR	53.5	50.0	3-5	186	186	595	160	95,232	66.1	190,464	132.3	285,696	198.4	20
B10	HDR	23.5	20.9	15-21	422	264	844	160	135,040	93.8	270,080	187.6	405,120	281.3	38
B11	HDR	19.9	15.7	5-8	358	224	716	160	114,560	79.6	229,120	159.1	343,680	238.7	11
B12	LDR	35.3	31.7	3-5	123	123	394	160	62,976	43.7	125,952	87.5	188,928	131.2	11
B13	LDR	30.4	27.9	3-5	99	99	317	160	50,688	35.2	101,376	70.4	152,064	105.6	14
B14	PARK	2.0	2.0		-	2	-	500	999	0.7	1,998	1.4	2,997	2.1	14
B15	LDR	35.2	31.6	3-5	127	127	406	160	65,024	45.2	130,048	90.3	195,072	135.5	27
B16	LDR	33.0	27.6	3-5	138	138	443	160	70,820	49.2	141,639	98.4	212,459	147.5	34
B17	LDR	45.8	39.5	3-5	149	149	477	160	76,288	53.0	152,576	106.0	228,864	158.9	33
B18	MDR	30.0	22.0	5-8	180	113	360	160	57,600	40.0	115,200	80.0	172,800	120.0	26
B19	PARK	2.0	2.0		-	2	-	500	999	0.7	1,998	1.4	2,997	2.1	33
B20	LDR	53.8	51.3	3-5	175	175	560	160	89,600	62.2	179,200	124.4	268,800	186.7	20
B21	COMM	22.0	18.9	-	-	108	-	2500	55,085	38.3	110,170	76.5	165,255	114.8	23
B22	HDR	46.2	38.4	15-21	831	519	1662	160	265,920	184.7	531,840	369.3	797,760	554.0	24
B23	COMM	11.5	8.5		-	56	-	2500	28,697	19.9	57,393	39.9	86,090	59.8	24
B24	COMM	20.9	18.3		-	102	-	2500	52,196	36.2	104,391	72.5	156,587	108.7	25
B25	HDR	15.8	11.2	15-21	284	178	568	160	90,880	63.1	181,760	126.2	272,640	189.3	26
B26	LDR	25.0	22.9	3-5	88	88	282	160	45,056	31.3	90,112	62.6	135,168	93.9	26
B27	MDR	43.7	41.7	3-5	262	262	838	160	134,144	93.2	268,288	186.3	402,432	279.5	25
B28	PARK	2.0	2.0		-	2	-	500	999	0.7	1,998	1.4	2,997	2.1	25
B29	LDR	47.8	42.9	3-5	155	155	496	160	79,360	55.1	158,720	110.2	238,080	165.3	25
B30	SCHOOL	14.0	11.8		1200	176	-	75	90,000	62.5	180,000	125.0	270,000	187.5	26
B31	PARK	15.1	12.5		-	15	-	500	7,552	5.2	15,103	10.5	22,655	15.7	21
B32	LDR	49.1	44.9	3-5	197	197	630	160	100,864	70.0	201,728	140.1	302,592	210.1	22
B33	MDR	23.7	17.3	5-8	142	89	284	160	45,457	31.6	90,913	63.1	136,370	94.7	27
B34	MDR	21.1	10.9	5-8	127	79	254	160	40,640	28.2	81,280	56.4	121,920	84.7	12
B35	LDR	32.0	28.0	3-5	109	109	349	160	55,808	38.8	111,616	77.5	167,424	116.3	22
B36	PARK	2.0	2.0		-	2	-	500	999	0.7	1,998	1.4	2,997	2.1	15
B37	LDR	24.3	19.2	3-5	78	78	250	160	39,936	27.7	79,872	55.5	119,808	83.2	15
B38	LDR	32.9	26.6	3-5	110	110	352	160	56,320	39.1	112,640	78.2	168,960	117.3	38
B39	COMM	6.6	4.7		-	32	-	2500	16,551	11.5	33,102	23.0	49,653	34.5	3
Phase 2	TOTAL	936.5	806.4		4,948	4,754	12,460		2,434,226	1,690.4	4,868,452	3,380.9	7,302,678	5,071.3	

Wells at 1.7 ADD 2,874 gpm
Average Day Maximum Month

Sun Haven - City of Surprise	TOTAL	1902.9	1561.1		8,001	8,194	21,722		4,195,190	2,913.3	8,390,379	5,826.7	12,585,569	8,740.0	

Wells at 1.7 ADD 4,953 gpm
Average Day Maximum Month

Area	Land Use	Gross Area[Ac]	Net Area[Ac]	Density [Du/Ac]	Target Total Density Units	EDU's	Population	Unit Demand (gpcd)	Average Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Peak Hour Demand (gpd)	Peak Hour Demand (gpm)	Assigned
West End Water Service Area															
B1	EMP	65.6	59.8	-	-	320	-	2500	164,048	113.9	328,096	227.8	492,144	341.8	18
B2	EMP	110.7	82.6	-	-	541	-	2500	276,750	192.2	553,500	384.4	830,250	576.6	18
B3	PUBLIC USE	2.5	2.1	-	-	12	-	2500	6,250	4.3	12,500	8.7	18,750	13.0	13
B4	Comm (1/2 COS)	37.8	31.0	-	-	185	-	2500	94,553	65.7	189,106	131.3	283,660	197.0	16
West End Water Service Area		216.6	175.5	0	0	1,058	0		541,601	376.1	1,083,202	752.2	1,624,804	1,128.3	

5.0 WATER SYSTEM MODELING

A computer model of the proposed water system has been prepared using the EPANET 2.0 Model from the Environmental Protection Agency. The computer program evaluates the proposed water system network to simulate the expected performance of a water system under a variety of flow demand conditions. The following scenarios have been analyzed.

- Average Day Demands
- Maximum Day Demands
- Maximum Day Demand with a Coincident Fire Flow applied at various locations in the system.
- Peak Hour

As water supply has been separated from the distribution system, a series of "views" under the above referenced flow demand conditions have been analyzed.

The following criteria were used for distribution design and modeling.

- Minimum Pressure = 40 psi static

- Maximum Pressure = 90 psi static
  Pressures exceeding 80 psi will require an individual pressure reducing valve on the customer side of the meter.

- Pressure Zone Adjustments – The pressure zone hydraulic gradelines for future zones 8 and 9 do not appear to fit well for the property due to its relationship with the Central Arizona Project Canal. This structure forms a logical zone break for the City of Surprise system. The models have been prepared based upon an HGL of 1760 for zone 8 (instead of the published 1730) and 1820 for Zone 9 (instead of the published 1810)

- Head loss in well lines is less than 10' per 1000' of pipe (8" minimum). A maximum of 8 feet per second with five wells operating at 1,000 gallons per minute has been used to establish preliminary line sizing.

- A velocity of less than 6.0 feet per second in the distribution system piping under all flow conditions.

- Fire Flow
  - 1,200 gallons per minute for all residential units
  - 1,750 gallons per minute for residential units greater than 3,600 square feet in size.
  - 3,000 gallons per minute for commercial and other non-single family residential properties

- Minimum Residual Pressure during fire flow modeling = 25 psi.

- Peaking factors used

  - All initial demands based upon average day
  - Average Day Maximum Month = 1.7 times Average Day
  - Maximum day = 2.0 times Average Day
  - Peak Hour = 3.0 times Average Day

- Hazen Williams Coefficient = 120 for all pipes

It is expected that the Zone 8 and 9 pump stations will be designed and constructed to serve Sunhaven property will include Variable Frequency Drive Pumps (VFD's). This will allow the 1760 pressure zone 8 hydraulic elevation and the 1820 pressure zone 9 to be maintained at the plant site. While a tank farm of equal elevation will be constructed, reservoirs with static water surface elevations of 1760 and 1820 have been used to model the pumping plants associated with this system.

The following scenarios have been analyzed.

- Average Day Demands
- Maximum Day Demands
- Maximum Day Demand with a Coincident Commercial Fire Flow at Node 13
- Maximum Day Demand with a Coincident Commercial Fire Flow at Node 26
- Peak Hour Demand

It should be noted that within the City of Surprise service area the Peak Hour Demand and the Maximum Day plus Commercial fire flow are almost the same value. Peak Hour Demand will govern the system size for Sunhaven. As noted in Table 1, the entire Peak Hour Demand for the development is shown as 8,740 gallons per minute. This is slightly less than the combination of a commercial fire flow demand of 3,000 gallons per minute and the Maximum Day Demand of 5,827 gallons per minute for a total of 8,827 gallons per minute.

Sunhaven Improvements

As Sunhaven will be constructed in phases, not all of the pipelines within the City of Surprise service area will be constructed with the first phase. The initial wells and associated well delivery line, one reservoir, chlorination, and zone 8 pumping facilities will be constructed with the initial phase of development.

A model of the Sunhaven water system was assembled to determine the expected performance of the water system's components under a variety of flow conditions. These conditions were used to size the system components, both to meet the design criteria and to determine the most cost efficient size of individual piping segments. In addition an allowance for additional treatment for the potential removal of Arsenic needs to be made

for the areas outside of Sunhaven in the event that the wells are found to exceed the future MCL for this metal.

The City of Surprise service area of Sunhaven could consist of 8,001 residential units, commercial property, elementary schools, and public parks/ facilities. An adjustment of these units has been made to reflect 8,194 Equivalent Dwelling Units (EDU). An additional 1,058 EDU's are expected in the future employment areas within the west End Water Company service area. For the purpose of this report an EDU is one unit that has 3.2 people per unit each using 160 gallons per capita per day on an Average Day.

The phase one construction and occupancy of Sunhaven would result in the following water demand values.

Proposed Lots	3,053 units
Equivalent Dwelling Units	3,439 EDU
Population based on Residential Units	9,262 people
Average Day Demand from EDUs	1.76 MGD
Average Day Demand (ADD)	1,223 gpm
Average Day Maximum Month at 1.7 times ADD (Well demand)	2,079 gpm
Maximum Day Demand at 2.0 times ADD	2,446 gpm
Maximum Day Demand plus commercial fire flow	5,446 gpm
Peak Hour Flow at 3.0 times ADD	3,669 gpm

6.0 RESULTS

The models were set up and used to evaluate the following scenarios for the Sunhaven water system. The fire flows was modeled as a demand at Nodes 13 and 26 in the system. These nodes were chosen to represent the most remote locations in the City of Surprise system from the water plant that requires a 3,000 gallon per minute fire flow.

- Average Day Flows
- Maximum Day Flows
- Peak Hour
- Maximum Day Flows plus a fire flow at Node13 – Zone 8 System
- Maximum Day Flows plus a fire flow at Node 26 – Zone 9 System

The model runs demonstrating the results for each of the above are included in the Appendix. The SUNHAVEN system performed within the design limits in all cases. It was necessary to adjust the pressure zone hydraulic grade lines as noted earlier in this report.

7.0 ON-SITE WATER PLANT IMPROVEMENTS

The on-site water facilities will include domestic wells, a well delivery line, storage reservoir(s), booster pump stations for each pressure zone, and water transmission mains. Each of the facilities will be designed with the following.

Water Wells

The City of Surprise requires 2 wells with a capacity of 1500 gpm each. While it is the City of Surprise's desire to have 3,000 gallons per minute of water produced from each square mile of the project, it may not be possible. Approximately three square miles of the project lies within the City of Surprise service area (6 wells) while the remaining half square mile lies within the West End Water Company service area. The area of the project within the West End Water Service Area will be handled separately with that Company.

The following criteria are provided to establish a basis for the minimum well development standards to be used for this project.

- The developer will provide the 2 wells per section within the City's service area as required by the City of Surprise.

- Each of the wells will be developed to the maximum safe yield that is determined during the well development. While it is the hope of the developer that 1,500 gallons per minute can be delivered from each of the wells, preliminary hydro-geology and a well developed on the site indicates that the potential safe yield from wells on this site may be less.

- Due to separation requirements of potable water wells and draw down concerns, the addition of wells on the property must be carefully planned. Our discussions with a hydro-geologist familiar with the area has given us a belief that certain areas of the project will have significantly better yields than others, but spacing of the wells will need to be maintained for maximum well yield and recovery.

- In addition to the six (6) wells, the developer will provide the water needs of the project based on the average day, maximum month criteria with redundancy. This criterion is proposed to establish minimum criteria for well production of the site. The project needs within the City of Surprise Service area for the Average Day maximum month is estimated at 4,953 gpm. This criterion also allows for maximum day demand for Sunhaven (5,827 gpm) to be met will all wells producing and zero support from the system's storage reservoirs.

- This report has been based upon the wells not being able to deliver production water at this level. It has been determined that the required 6 wells, with a minimum of 990 gallons per minute of production each, will be sufficient to service the property. This allows for 5 wells to be in operation to meet the Average Day Maximum Month demand (1.7 times Average Day Demand) with one well in reserve. 1,000 gallons per minute for all wells has been used in the sizing of the well line facilities. As the locations of the wells have yet to be determined this was deemed as a conservative estimate for the sizing of the well lines.

Well Delivery Pipe Lines

A 12-inch line (8-inch if well production is 1,000 gpm or less) will be required to connect each well to the well delivery main. A maximum velocity of 8 fps with all wells running at 1,000 gpm was used in selecting the pipe sizes.

Storage Reservoir

The storage for the project will meet the following criteria

> "The City (of Surprise) requires a 1,200,000 gallon storage tank system, ... per square mile"

While the City of Surprise requires 1.2 million gallons of storage for each section of land, the IWMP cites criteria that use the Average day demand not depleting more than 80

percent of the storage. Both the IWMP and City of Surprise Code methods for determining the storage volume requested for the Sunhaven Development have been reviewed. Based upon the Sun Haven Area (not including the portion within the West Side Water Company service area) a total of 3.57 MG of storage would be required based upon the current City code while the IWMP method would require 5.24 MG. There are concerns with potential water quality issues that may occur with excess water storage that can not be used on a regular basis. It is the desire of this master plan to size the storage appropriately for the intended use.

As a check, these volume requirements were compared using other calculation methods including Arizona American Water Company, AAWC Agua Fria Master Plan Criteria, ADEQ Bulletin 10 Criteria, and City of Scottsdale Criteria. These methods yield storage requirements that range from 2.6 MG to 4.9 MG. Based upon a review of these methods and the intent of the IWMP we recommend the following:

- 3.6 MG storage is proposed. This represents a median of the methods reviewed and is consistent with current City of Surprise code.

- One of the wells required for water production will be drilled on the water campus site and be tied into the emergency backup power system for the site.

The addition of a well with backup power is described in Bulletin 10 and will allow for the reduction in the Average Daily Demand depletion. When the estimated safe yield for 90 percent of an anticipated Sun Haven Well of 900 gpm is applied to the ADD within IWMP criteria a storage requirement of 3.80 MG is obtained. In addition, when a factor of depletion of 87.5 percent rather than 80 percent is applied to the reservoir sizing, a volume of 3.48 MG is required. The 87.5 percentage represents 2 feet of a 16 foot tank being unusable storage.

Booster Pump Station

In order to provide adequate supply and pressure for the entire project, on-site booster pump station(s) will be required. It is expected that the following facilities will be required for the both Zone 8 and 9 pumping stations

- Motor driven pumps
- Hydro-pneumatic Tank and accessories (if required by City of Surprise)
- Chlorination equipment – Gas chlorination
- Electrical equipment and controls for pump motors
- Telemetry equipment – RTU
- Masonry screen wall and landscaping adjustments
- Emergency generator equipment

Pumping equipment will be designed to meet City of Surprise requirements to minimize the stocking of replacement parts. The firm capacity of the station will meet or exceed the greater of the peak hour flow or the maximum day plus fire flow. The firm capacity

is defined as the pump station running with the largest pump out of service. The fire flow used in the design will be 3000 gpm, non-residential demand.

A "Basis of Design" report will be submitted to the City of Surprise with the design of the booster pump station(s). This report will use the Darcy- Weisbach equation for headloss for determination in the pump selection.

Transmission Main

The pipe sizes are shown on the enclosed exhibits for the master system of Sunhaven. The remaining looped pipes within each development will be a minimum of 8" in diameter.

Pipeline materials allowed on this project will be in accordance with City of Surprise standards.

8.0 SUMMARY

The water system for Sunhaven will be constructed and operated in accordance with City of Surprise, county, state and corporation commission regulations. The system has been sized and evaluated using the greater of the peak hour or Maximum Day plus Commercial fire demand.

APPENDIX A

SUNHAVEN
WATER SYSTEM ANALYSIS MODELS

- Average Day
- Maximum Day
- Peak Hour
- Fire Flow Analysis

Water by Node

Sunhaven Concept Water Master Plan
Without West End Water

Area	Average Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Peak Hour Demand (gpd)	Peak Hour Demand (gpm)	Assigned	Total ADD @ Node in gpm	Total with split flows in gpm
A11	45,144	31.4	90,289	62.7	135,433	94.1	3		
A19	999	0.7	1,998	1.4	2,997	2.1	3		
A20	35,086	24.4	70,172	48.7	105,258	73.1	3		
A21	47,289	32.8	94,577	65.7	141,866	98.5	3		
B39	16,551	11.5	33,102	23.0	49,653	34.5	3	100.7	100.7
A13	71,858	49.9	143,716	99.8	215,573	149.7	4		
A15	44,524	30.9	89,049	61.8	133,573	92.8	4		
A16	999	0.7	1,998	1.4	2,997	2.1	4		
A17	39,672	27.6	79,345	55.1	119,017	82.7	4		
A18	34,958	24.3	69,915	48.6	104,873	72.8	4		
A26	31,790	22.1	63,581	44.2	95,371	66.2	4		
A4	999	0.7	1,998	1.4	2,997	2.1	4	156.1	156.1
A23	49,444	34.3	98,889	68.7	148,333	103.0	5		
A35	58,829	40.9	117,657	81.7	176,486	122.6	5	75.2	102.1
A36	80,244	55.7	160,488	111.4	240,732	167.2	6		
A37	46,990	32.6	93,981	65.3	140,971	97.9	6	88.4	88.4
A29	999	0.7	1,998	1.4	2,997	2.1	8		
A30	53,099	36.9	106,199	73.7	159,298	110.6	8		
A33	68,803	47.8	137,606	95.6	206,499	143.4	8	85.4	85.4
A12	51,262	35.6	102,524	71.2	153,786	106.8	9		
A14	33,063	23.0	66,165	45.9	99,248	68.9	9		
A6	40,438	28.1	80,876	56.2	121,314	84.2	9		
A7	1,705	1.2	3,409	2.4	5,114	3.6	9		
A8	23,183	16.1	46,366	32.2	69,550	48.3	9	103.9	103.9
A3	95,981	66.7	191,961	133.3	287,942	200.0	10	66.7	66.7
A9	73,624	51.1	147,248	102.3	220,873	153.4	11		
B11	114,560	79.6	229,120	159.1	343,680	238.7	11		
B12	62,976	43.7	125,952	87.5	188,928	131.2	11	174.4	174.4
A10	21,555	15.0	43,111	29.9	64,666	44.9	12		
B34	40,640	28.2	81,280	56.4	121,920	84.7	12	43.2	43.2
B13	50,688	35.2	101,376	70.4	152,064	105.6	14		
B14	999	0.7	1,998	1.4	2,997	2.1	14	35.9	35.9
B36	999	0.7	1,998	1.4	2,997	2.1	15		
B37	39,936	27.7	79,872	55.5	119,808	83.2	15	28.4	55.4
A1	113,811	79.0	227,622	158.1	341,434	237.1	16		
B4	94,553	65.7	189,106	131.3	283,660	197.0	16	144.7	144.7
A2	135,581	94.2	271,162	188.3	406,743	282.5	17		
A5	56,975	39.6	113,950	79.1	170,926	118.7	17	133.7	133.7
B8	72,315	50.2	144,630	100.4	216,945	150.7	19	50.2	50.2
B20	89,600	62.2	179,200	124.4	268,800	186.7	20		
B9	95,232	66.1	190,464	132.3	285,696	198.4	20	128.4	128.4
B31	7,552	5.2	15,103	10.5	22,655	15.7	21	5.2	5.2
B32	100,864	70.0	201,728	140.1	302,592	210.1	22		
B35	55,808	38.8	111,616	77.5	167,424	116.3	22	108.8	108.8
B21	55,085	38.3	110,170	76.5	165,255	114.8	23	38.3	38.3
B22	265,920	184.7	531,840	369.3	797,760	554.0	24		
B23	28,697	19.9	57,393	39.9	86,090	59.8	24	204.6	204.6
B24	52,196	36.2	104,391	72.5	156,587	108.7	25		
B27	134,144	93.2	268,288	186.3	402,432	279.5	25		
B28	999	0.7	1,998	1.4	2,997	2.1	25		
B29	79,360	55.1	158,720	110.2	238,080	165.3	25	185.2	185.2
B18	57,600	40.0	115,200	80.0	172,800	120.0	26		
B25	90,880	63.1	181,760	126.2	272,640	189.3	26		
B26	45,056	31.3	90,112	62.6	135,168	93.9	26		
B30	90,000	62.5	180,000	125.0	270,000	187.5	26	196.9	196.9
B15	65,024	45.2	130,048	90.3	195,072	135.5	27		
B33	45,457	31.6	90,913	63.1	136,370	94.7	27	76.7	76.7
A24	46,179	32.1	92,358	64.1	138,536	96.2	30		
A25	42,327	29.4	84,654	58.8	126,982	88.2	30		
A27	38,581	26.8	77,162	53.6	115,742	80.4	30		
A31	50,531	35.1	101,062	70.2	151,593	105.3	30		
A32	90,000	62.5	180,000	125.0	270,000	187.5	30		
A34	999	0.7	1,998	1.4	2,997	2.1	30	186.5	186.5
A28	55,848	38.8	111,695	77.6	167,543	116.3	32	38.8	38.8
B17	76,288	53.0	152,576	106.0	228,864	158.9	33		
B19	999	0.7	1,998	1.4	2,997	2.1	33	53.7	53.7
B16	70,820	49.2	141,639	98.4	212,459	147.5	34		
B7	90,000	62.5	180,000	125.0	270,000	187.5	34	111.7	111.7
B38	56,320	39.1	112,640	78.2	168,960	117.3	36	39.1	39.1
B10	135,040	93.8	270,080	187.6	405,120	281.3	38		
B5	149,120	103.6	298,240	207.1	447,360	310.7	38	197.3	197.3
B6	1,950	1.4	3,900	2.7	5,850	4.1	39	1.4	1.4
A22	77,544	53.8	155,088	107.7	232,631	161.5	5, 15	26.9	each
Phase 2	4,195,190	2,913.3	8,390,379	5,826.7	12,585,569	8,740.0			2,913.3

Sun Haven City of Surprise	4,195,190	2,913.3	8,390,379	5,826.7	12,585,569	8,740.0

Area	Average Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Peak Hour Demand (gpd)	Peak Hour Demand (gpm)	Assigned	Total ADD @ Node in gpm	Total with split flows in gpm
West End Water Service Area									
B1	164,048	113.9	328,096	227.8	492,144	341.8	98		
B2	276,750	192.2	553,500	384.4	830,250	576.6	98	306.1	306.1
B3	6,250	4.3	12,500	8.7	18,750	13.0	99		
B4	94,553	65.7	189,106	131.3	283,660	197.0	99	70.0	70.0
West End Water Service Area	541,601	376.1	1,083,202	752.2	1,624,804	1,128.3			376.1

Node by phase

Sunhaven Concept Water Master Plan

Area	Average Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Peak Hour Demand (gpd)	Peak Hour Demand (gpm)	Assigned	Total ADD @ Node in gpm	Total with split flows in gpm
Phase 1									
A11	45,144	31.4	90,289	62.7	135,433	94.1	3		
A19	999	0.7	1,998	1.4	2,997	2.1	3		
A20	35,086	24.4	70,172	48.7	105,258	73.1	3		
A21	47,289	32.8	94,577	65.7	141,866	98.5	3	89.2	89.2
A4	999	0.7	1,998	1.4	2,997	2.1	4		
A13	71,858	49.9	143,716	99.8	215,573	149.7	4		
A15	44,524	30.9	89,049	61.8	133,573	92.8	4		
A16	999	0.7	1,998	1.4	2,997	2.1	4		
A17	39,672	27.6	79,345	55.1	119,017	82.7	4		
A18	34,958	24.3	69,915	48.6	104,873	72.8	4		
A26	31,790	22.1	63,581	44.2	95,371	66.2	4	156.1	156.1
A23	49,444	34.3	98,889	68.7	148,333	103.0	5		
A35	58,829	40.9	117,657	81.7	176,486	122.6	5	75.2	102.1
A36	80,244	55.7	160,488	111.4	240,732	167.2	6		
A37	46,990	32.6	93,981	65.3	140,971	97.9	6	88.4	88.4
A29	999	0.7	1,998	1.4	2,997	2.1	8		
A30	53,099	36.9	106,199	73.7	159,298	110.6	8		
A33	68,833	47.8	137,666	95.6	206,499	143.4	8	85.4	85.4
A6	40,438	28.1	80,876	56.2	121,314	84.2	9		
A7	1,705	1.2	3,409	2.4	5,114	3.6	9		
A8	23,183	16.1	46,366	32.2	69,550	48.3	9		
A12	51,262	35.6	102,524	71.2	153,786	106.8	9		
A14	33,083	23.0	66,165	45.9	99,248	68.9	9	103.9	103.9
A3	95,981	66.7	191,961	133.3	287,942	200.0	10	66.7	66.7
A9	73,624	51.1	147,248	102.3	220,873	153.4	11	51.1	51.1
A10	21,555	15.0	43,111	29.9	64,666	44.9	12	15.0	15.0
A1	113,811	79.0	227,622	158.1	341,434	237.1	16	79.0	79.0
A2	135,581	94.2	271,162	188.3	406,743	282.5	17		
A5	56,975	39.6	113,950	79.1	170,926	118.7	17	133.7	133.7
A24	46,179	32.1	92,358	64.1	138,536	96.2	30		
A25	42,327	29.4	84,654	58.8	126,982	88.2	30		
A27	38,581	26.8	77,162	53.6	115,742	80.4	30		
A31	50,531	35.1	101,062	70.2	151,593	105.3	30		
A32	90,000	62.5	180,000	125.0	270,000	187.5	30		
A34	999	0.7	1,998	1.4	2,997	2.1	30	186.5	213.5
A28	55,848	38.8	111,695	77.6	167,543	116.3	32	38.8	38.8
A22	77,544	53.8	155,088	107.7	232,631	161.5	5, 15	26.9	each
Phase 1	1,760,964	1,222.9	3,521,927	2,445.8	5,282,891	3,668.7			1,222.9

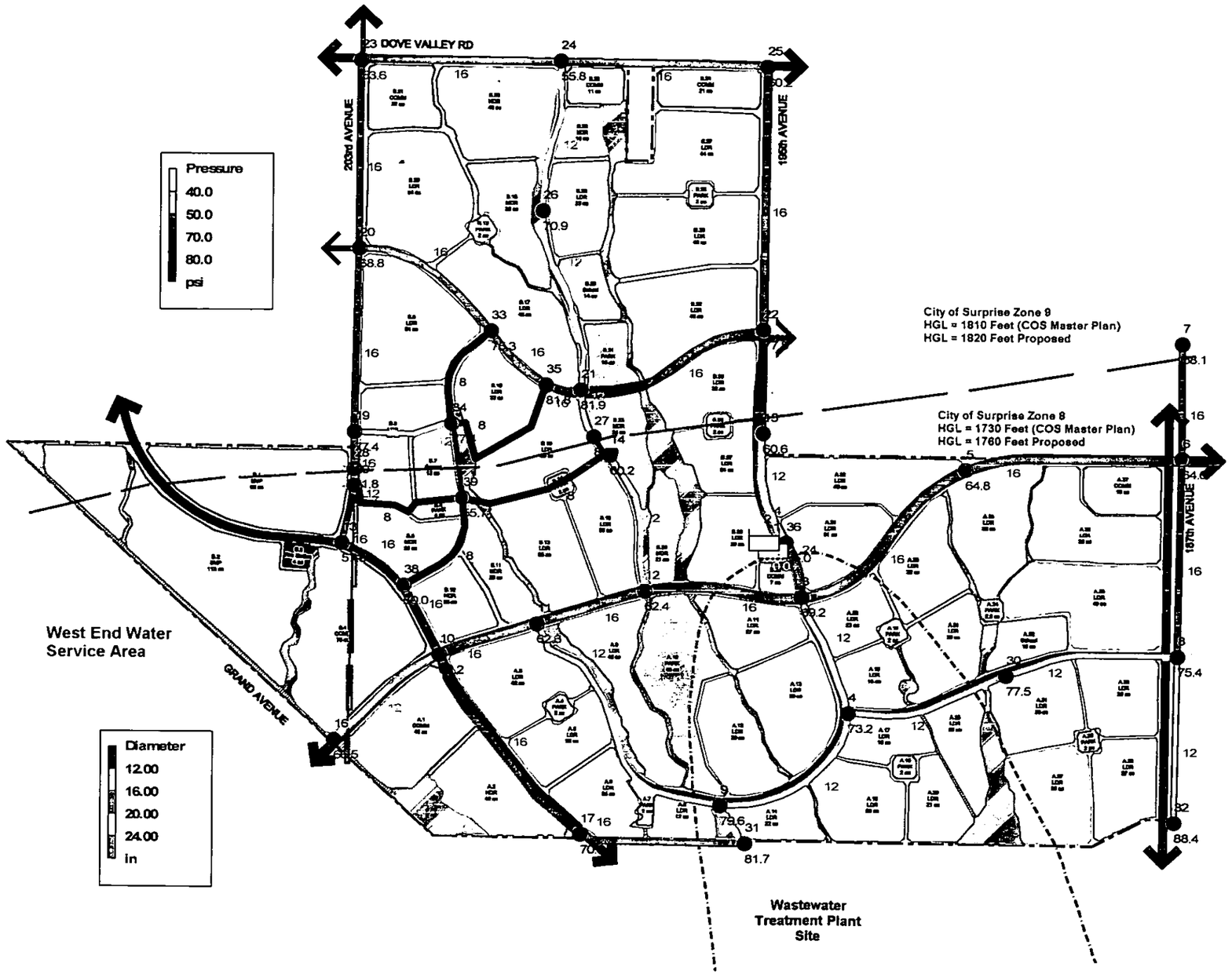
Area	Average Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Peak Hour Demand (gpd)	Peak Hour Demand (gpm)	Assigned	Total ADD @ Node in gpm	Total with split flows in gpm
Phase 2									
B39	16,551	11.5	33,102	23.0	49,653	34.5	3	11.5	11.5
B11	114,560	79.6	229,120	159.1	343,680	238.7	11		
B12	62,976	43.7	125,952	87.5	188,928	131.2	11	123.3	123.3
B34	40,640	28.2	81,280	56.4	121,920	84.7	12	28.2	28.2
B13	50,688	35.2	101,376	70.4	152,064	105.6	14		
B14	999	0.7	1,998	1.4	2,997	2.1	14	35.9	35.9
B36	999	0.7	1,998	1.4	2,997	2.1	15		
B37	39,936	27.7	79,872	55.5	119,808	83.2	15	28.4	28.4
B4	94,553	65.7	189,106	131.3	283,660	197.0	16	65.7	65.7
B8	72,315	50.2	144,630	100.4	216,945	150.7	19	50.2	50.2
B9	95,232	66.1	190,464	132.3	285,696	198.4	20		
B20	89,600	62.2	179,200	124.4	268,800	186.7	20	128.4	128.4
B31	7,552	5.2	15,103	10.5	22,655	15.7	21	5.2	5.2
B32	100,864	70.0	201,728	140.1	302,592	210.1	22		
B35	55,808	38.8	111,616	77.5	167,424	116.3	22	108.8	108.8
B21	55,085	38.3	110,170	76.5	165,255	114.8	23	38.3	38.3
B22	265,920	184.7	531,840	369.3	797,760	554.0	24		
B23	28,697	19.9	57,393	39.9	86,090	59.8	24	204.6	204.6
B24	52,196	36.2	104,391	72.5	156,587	108.7	25		
B27	134,144	93.2	268,288	186.3	402,432	279.5	25		
B28	999	0.7	1,998	1.4	2,997	2.1	25		
B29	79,360	55.1	158,720	110.2	238,080	165.3	25	185.2	185.2
B18	57,600	40.0	115,200	80.0	172,800	120.0	26		
B25	90,880	63.1	181,760	126.2	272,640	189.3	26		
B26	45,056	31.3	90,112	62.6	135,168	93.9	26		
B30	90,000	62.5	180,000	125.0	270,000	187.5	26	196.9	196.9
B15	65,024	45.2	130,048	90.3	195,072	135.5	27		
B33	45,457	31.6	90,913	63.1	136,370	94.7	27	76.7	76.7
B17	76,288	53.0	152,576	106.0	228,864	158.9	33		
B19	999	0.7	1,998	1.4	2,997	2.1	33	53.7	53.7
B7	90,000	62.5	180,000	125.0	270,000	187.5	34		
B16	70,820	49.2	141,639	98.4	212,459	147.5	34	111.7	111.7
B38	56,320	39.1	112,640	78.2	168,960	117.3	36	39.1	39.1
B5	149,120	103.6	298,240	207.1	447,360	310.7	38		
B10	135,040	93.8	270,080	187.6	405,120	281.3	38	197.3	197.3
B6	1,950	1.4	3,900	2.7	5,850	4.1	39	1.4	1.4
Phase 2	2,434,226	1,690.4	4,868,452	3,380.9	7,302,678	5,071.3			1,690.4

Sun Haven City of Surprise	4,195,190	2,913.3	8,390,379	5,826.7	12,585,569	8,740.0

Area	Average Day Demand (gpd)	Average Day Demand (gpm)	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Peak Hour Demand (gpd)	Peak Hour Demand (gpm)	Assigned	Total ADD @ Node in gpm	Total with split flows in gpm
West End Water Service Area									
B1	164,048	113.9	328,096	227.8	492,144	341.8	98		
B2	276,750	192.2	553,500	384.4	830,250	576.6	98	306.1	306.1
B3	6,250	4.3	12,500	8.7	18,750	13.0	99		
B4	94,553	65.7	189,106	131.3	283,660	197.0	99	70.0	70.0
West End Water Service Area	541,601	376.1	1,083,202	752.2	1,624,804	1,128.3			376.1

Average Day Demand

Day 1, 12:00 AM



Sunhaven

City of Surprise, Arizona

Planned Area Development

Master Water Plan

LEGEND

- Low Density Residential (3-5 du/ac)
- Medium Density Residential (5-8 du/ac)
- High Density Residential (15-21 du/ac)
- Commercial
- Park/Open Space
- Multi Use/ Employment
- School
- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary
- 65 Ldn Line
- Parcel Label: Parcel Number / Land Use Designation / Gross Acreage

EPANET 2

NORTH

Not To Scale

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8503

Average Day Demand

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 3	1600	100.7	100.70	1759.81	69.25
Junc 4	1590	156.1	156.10	1758.86	73.17
Junc 5	1610	102.1	102.10	1759.45	64.76
Junc 6	1610	88.4	88.40	1759.13	64.62
Junc 7	1625	0	0.00	1759.13	58.12
Junc 8	1585	85.4	85.40	1758.98	75.39
Junc 9	1575	103.9	103.90	1758.63	79.57
Junc 10	1615	66.7	66.70	1758.53	62.19
Junc 11	1615	174.4	174.40	1758.68	62.26
Junc 12	1615	43.2	43.20	1759.04	62.41
Junc 13	1625	0	0.00	1758.52	57.85
Junc 14	1620	35.9	35.90	1758.91	60.19
Junc 15	1620	55.4	55.40	1759.92	60.63
Junc 16	1605	144.7	144.70	1758.39	66.46
Junc 17	1595	133.7	133.70	1758.53	70.86
Junc 19	1640	50.2	50.20	1818.70	77.43
Junc 21	1630	5.2	5.20	1818.91	81.85
Junc 22	1640	108.8	108.80	1819.60	77.82
Junc 26	1655	196.9	196.90	1818.71	70.93

Average Day Demand

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 27	1625	76.7	76.70	1818.87	84.00
Junc 28	1630	0	0.00	1818.70	81.77
Junc 29	1630	0	0.00	1758.52	55.69
Junc 30	1580	186.5	186.50	1758.83	77.49
Junc 31	1570	0	0.00	1758.56	81.70
Junc 32	1555	38.8	38.80	1758.96	88.38
Junc 24	1690	204.6	204.60	1818.72	55.78
Junc 25	1680	185.2	185.20	1818.93	60.20
Junc 23	1695	38.3	38.30	1818.72	53.61
Junc 20	1660	128.4	128.40	1818.72	68.77
Junc 33	1645	53.7	53.70	1818.77	75.29
Junc 34	1640	111.7	111.70	1818.70	77.43
Junc 35	1630	0	0.00	1818.84	81.82
Junc 36	1610	39.1	39.10	1759.94	64.97
Junc 38	1620	197.3	197.30	1758.51	60.02
Junc 39	1630	1.4	1.40	1758.59	55.72
Resvr 1	1760	#N/A	-1753.70	1760.00	0.00
Resvr 2	1820	#N/A	-1159.70	1820.00	0.00

Average Day Demand

Network Table - Links

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 7	2800	16	120	-561.96	0.90	0.25	0.027	Open
Pipe 9	2400	12	120	-145.64	0.41	0.08	0.031	Open
Pipe 10	1000	12	100	76.70	0.22	0.04	0.048	Open
Pipe 14	1900	16	120	733.44	1.17	0.41	0.026	Open
Pipe 15	2200	12	120	120.25	0.34	0.06	0.032	Open
Pipe 16	1400	16	120	-569.99	0.91	0.26	0.027	Open
Pipe 17	1600	16	120	337.80	0.54	0.10	0.029	Open
Pipe 22	3400	12	120	57.79	0.16	0.01	0.036	Open
Pipe 23	2000	12	120	375.26	1.06	0.48	0.027	Open
Pipe 24	2100	12	120	167.76	0.48	0.11	0.031	Open
Pipe 25	2400	12	120	51.39	0.15	0.01	0.037	Open
Pipe 26	2100	12	120	-135.11	0.38	0.07	0.032	Open
Pipe 27	2600	16	120	259.31	0.41	0.06	0.030	Open
Pipe 29	2300	16	120	-121.65	0.19	0.01	0.033	Open
Pipe 30	1200	12	120	-121.65	0.35	0.06	0.032	Open
Pipe 31	3200	16	120	12.05	0.02	0.00	0.044	Open
Pipe 32	1700	12	120	-144.70	0.41	0.08	0.031	Open
Pipe 34	1000	16	120	0.00	0.00	0.00	0.000	Open
Pipe 36	2600	12	120	38.80	0.11	0.01	0.038	Open

Average Day Demand

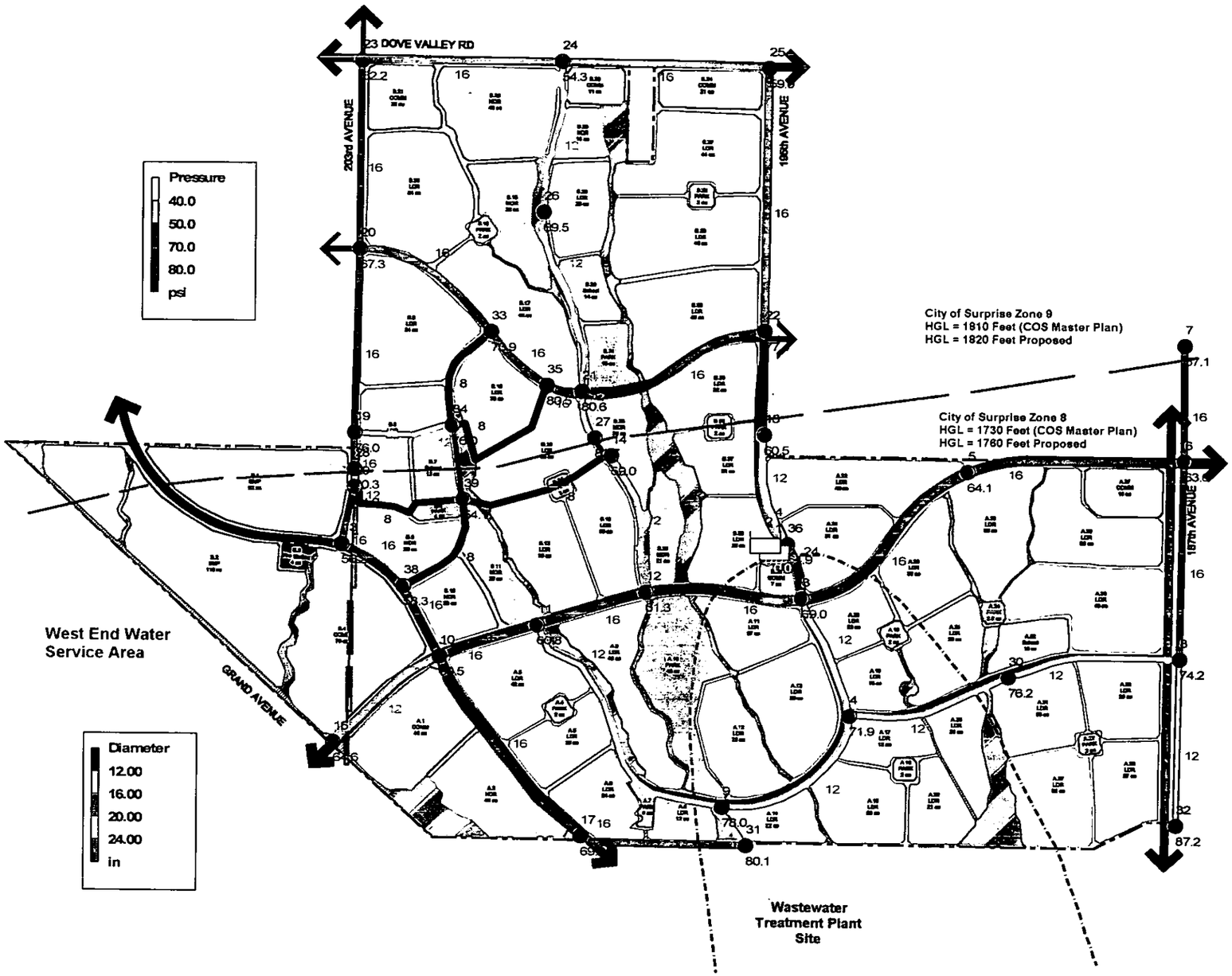
Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 3	500	24	120	1659.20	1.18	0.26	0.024	Open
Pipe 4	200	24	120	1753.70	1.24	0.28	0.024	Open
Pipe 5	3000	24	120	1159.70	0.82	0.13	0.025	Open
Pipe 6	1500	12	120	-55.40	0.16	0.01	0.036	Open
Pipe 8	2200	16	120	449.81	0.72	0.16	0.027	Open
Pipe 11	3100	16	120	347.71	0.55	0.10	0.029	Open
Pipe 12	1700	16	120	-186.29	0.30	0.03	0.031	Open
Pipe 13	1000	16	120	-281.28	0.45	0.07	0.029	Open
Pipe 28	700	16	120	-334.42	0.53	0.10	0.029	Open
Pipe 35	500	16	120	0.00	0.00	0.00	0.000	Open
Pipe 37	1200	12	120	17.27	0.05	0.00	0.041	Open
Pipe 38	1200	8	120	41.29	0.26	0.06	0.036	Open
Pipe 39	1500	8	120	-53.14	0.34	0.09	0.034	Open
Pipe 40	2600	16	120	-67.47	0.11	0.00	0.037	Open
Pipe 41	2600	16	120	9.58	0.02	0.00	0.052	Open
Pipe 42	2600	16	120	-47.88	0.08	0.00	0.038	Open
Pipe 43	1300	12	120	51.26	0.15	0.01	0.036	Open
Pipe 44	2600	16	120	-303.74	0.48	0.08	0.029	Open
Pipe 45	3500	16	120	-488.94	0.78	0.19	0.027	Open
Pipe 46	1200	8	120	-40.79	0.26	0.06	0.036	Open

Average Day Demand

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 47	1500	8	120	-84.35	0.54	0.22	0.032	Open
Pipe 48	1200	8	120	42.15	0.27	0.06	0.036	Open
Pipe 49	1000	16	120	40.79	0.07	0.00	0.040	Open
Pipe 50	1000	16	120	-114.35	0.18	0.01	0.034	Open
Pipe 51	1200	16	120	-40.79	0.07	0.00	0.039	Open
Valve 21	#N/A	12	#N/A	0.00	0.00	0.00	0.000	Closed

Maximum Day Demand

Day 1, 12:00 AM



Sunhaven

City of Surprise, Arizona

Planned Area Development

Master Water Plan

LEGEND

- Low Density Residential (3-5 du/ac)
- Medium Density Residential (5-8 du/ac)
- High Density Residential (15-21 du/ac)
- Commerical
- Park/Open Space
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- School
- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary
- 65 Ldn Line
- Parcel Label:

NORTH

Not To Scale

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8503

Maximum Day Demand

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 3	1600	100.7	201.40	1759.33	69.0
Junc 4	1590	156.1	312.20	1755.88	71.9
Junc 5	1610	102.1	204.20	1758.02	64.1
Junc 6	1610	88.4	176.80	1756.88	63.6
Junc 7	1625	0	0.00	1756.88	57.1
Junc 8	1585	85.4	170.80	1756.32	74.2
Junc 9	1575	103.9	207.80	1755.06	78.0
Junc 10	1615	66.7	133.40	1754.68	60.5
Junc 11	1615	174.4	348.80	1755.24	60.8
Junc 12	1615	43.2	86.40	1756.54	61.3
Junc 13	1625	0	0.00	1754.64	56.2
Junc 14	1620	35.9	71.80	1756.07	59.0
Junc 15	1620	55.4	110.80	1759.72	60.5
Junc 16	1605	144.7	289.40	1754.18	64.6
Junc 17	1595	133.7	267.40	1754.68	69.2
Junc 19	1640	50.2	100.40	1815.32	76.0
Junc 21	1630	5.2	10.40	1816.05	80.6
Junc 22	1640	108.8	217.60	1818.57	77.4
Junc 26	1655	196.9	393.80	1815.33	69.5

Maximum Day Demand

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 27	1625	76.7	153.40	1815.92	82.7
Junc 28	1630	0	0.00	1815.32	80.3
Junc 29	1630	0	0.00	1754.65	54.0
Junc 30	1580	186.5	373.00	1755.77	76.2
Junc 31	1570	0	0.00	1754.80	80.1
Junc 32	1555	38.8	77.60	1756.25	87.2
Junc 24	1690	204.6	409.20	1815.39	54.3
Junc 25	1680	185.2	370.40	1816.14	59.0
Junc 23	1695	38.3	76.60	1815.37	52.2
Junc 20	1660	128.4	256.80	1815.36	67.3
Junc 33	1645	53.7	107.40	1815.56	73.9
Junc 34	1640	111.7	223.40	1815.31	76.0
Junc 35	1630	0	0.00	1815.81	80.5
Junc 36	1610	39.1	78.20	1759.79	64.9
Junc 38	1620	197.3	394.60	1754.64	58.3
Junc 39	1630	1.4	2.80	1754.90	54.1
Resvr 1	1760	#N/A	-3507.40	1760.00	0.0
Resvr 2	1820	#N/A	-2319.40	1820.00	0.0

Maximum Day Demand

Network Table - Links

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 7	2800	16	120	-1123.92	1.79	0.90	0.024	Open
Pipe 9	2400	12	120	-291.27	0.83	0.30	0.028	Open
Pipe 10	1000	12	100	153.40	0.44	0.13	0.044	Open
Pipe 14	1900	16	120	1466.87	2.34	1.47	0.023	Open
Pipe 15	2200	12	120	240.49	0.68	0.21	0.029	Open
Pipe 16	1400	16	120	-1139.98	1.82	0.92	0.024	Open
Pipe 17	1600	16	120	675.60	1.08	0.35	0.026	Open
Pipe 22	3400	12	120	115.57	0.33	0.05	0.032	Open
Pipe 23	2000	12	120	750.51	2.13	1.73	0.025	Open
Pipe 24	2100	12	120	335.53	0.95	0.39	0.028	Open
Pipe 25	2400	12	120	102.78	0.29	0.04	0.033	Open
Pipe 26	2100	12	120	-270.22	0.77	0.26	0.029	Open
Pipe 27	2600	16	120	518.62	0.83	0.21	0.027	Open
Pipe 29	2300	16	120	-243.30	0.39	0.05	0.030	Open
Pipe 30	1200	12	120	-243.30	0.69	0.21	0.029	Open
Pipe 31	3200	16	120	24.10	0.04	0.00	0.042	Open
Pipe 32	1700	12	120	-289.40	0.82	0.30	0.028	Open
Pipe 34	1000	16	120	0.00	0.00	0.00	0.000	Open
Pipe 36	2600	12	120	77.60	0.22	0.03	0.034	Open

Maximum Day Demand

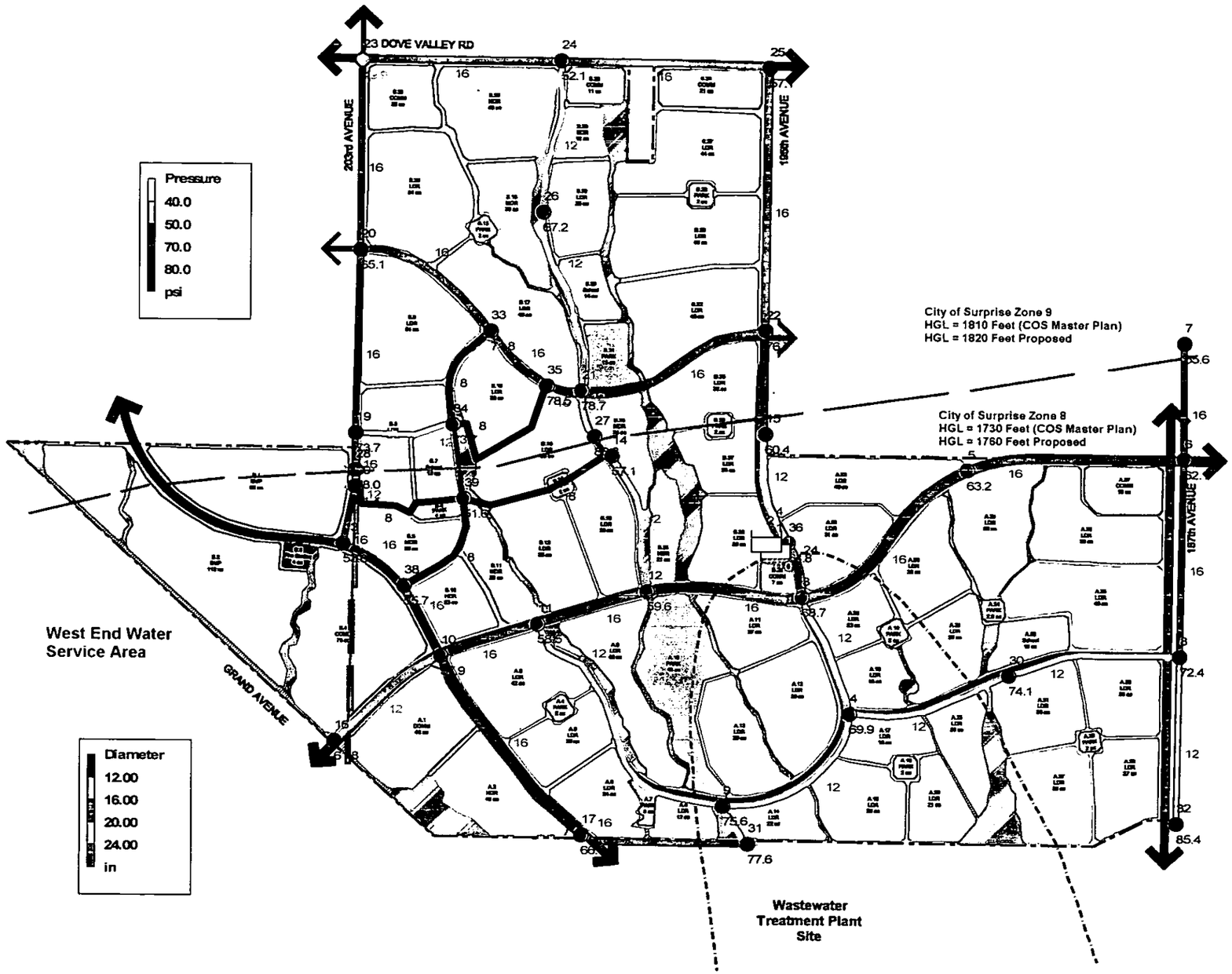
Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 3	500	24	120	3318.40	2.35	0.93	0.022	Open
Pipe 4	200	24	120	3507.40	2.49	1.03	0.021	Open
Pipe 5	3000	24	120	2319.40	1.64	0.48	0.023	Open
Pipe 6	1500	12	120	-110.80	0.31	0.05	0.033	Open
Pipe 8	2200	16	120	899.62	1.44	0.60	0.025	Open
Pipe 11	3100	16	120	695.42	1.11	0.37	0.026	Open
Pipe 12	1700	16	120	-372.58	0.59	0.12	0.028	Open
Pipe 13	1000	16	120	-562.56	0.90	0.25	0.027	Open
Pipe 28	700	16	120	-668.85	1.07	0.34	0.026	Open
Pipe 35	500	16	120	-0.00	0.00	0.00	0.000	Open
Pipe 37	1200	12	120	34.54	0.10	0.01	0.039	Open
Pipe 38	1200	8	120	82.58	0.53	0.21	0.032	Open
Pipe 39	1500	8	120	-106.29	0.68	0.33	0.031	Open
Pipe 40	2600	16	120	-134.94	0.22	0.02	0.033	Open
Pipe 41	2600	16	120	19.15	0.03	0.00	0.043	Open
Pipe 42	2600	16	120	-95.75	0.15	0.01	0.035	Open
Pipe 43	1300	12	120	102.53	0.29	0.04	0.033	Open
Pipe 44	2600	16	120	-607.48	0.97	0.29	0.026	Open
Pipe 45	3500	16	120	-977.88	1.56	0.69	0.024	Open
Pipe 46	1200	8	120	-81.59	0.52	0.20	0.032	Open

Maximum Day Demand

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 47	1500	8	120	-168.69	1.08	0.78	0.029	Open
Pipe 48	1200	8	120	84.31	0.54	0.22	0.032	Open
Pipe 49	1000	16	120	81.59	0.13	0.01	0.035	Open
Pipe 50	1000	16	120	-228.71	0.36	0.05	0.030	Open
Pipe 51	1200	16	120	-81.59	0.13	0.01	0.036	Open
Valve 21	#N/A	12	#N/A	0.00	0.00	0.00	0.000	Closed

Peak Hour Demand

Day 1, 12:00 AM



Sunhaven

City of Surprise, Arizona

Planned Area Development

Master Water Plan

LEGEND

- Low Density Residential (3-5 du/ac)
- Medium Density Residential (5-8 du/ac)
- High Density Residential (15-21 du/ac)
- Commercial
- Park/Open Space
- Multi Use/ Employment
- School
- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary
- 65 Ldn Line
- Parcel Label: Parcel Number, Land Use Designation, Gross Acreage

NORTH

Not To Scale

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8505

Peak Hour Demand

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 27	1625	76.7	230.10	1811.36	80.8
Junc 28	1630	0	0.00	1810.08	78.0
Junc 29	1630	0	0.00	1748.67	51.4
Junc 30	1580	186.5	559.50	1751.04	74.1
Junc 31	1570	0	0.00	1748.99	77.6
Junc 32	1555	38.8	116.40	1752.06	85.4
Junc 24	1690	204.6	613.80	1810.23	52.1
Junc 25	1680	185.2	555.60	1811.82	57.1
Junc 23	1695	38.3	114.90	1810.18	49.9
Junc 20	1660	128.4	385.20	1810.18	65.1
Junc 33	1645	53.7	161.10	1810.60	71.8
Junc 34	1640	111.7	335.10	1810.06	73.7
Junc 35	1630	0	0.00	1811.12	78.5
Junc 36	1610	39.1	117.30	1759.57	64.8
Junc 38	1620	197.3	591.90	1748.63	55.7
Junc 39	1630	1.4	4.20	1749.19	51.6
Resvr 1	1760	#N/A	-5261.10	1760.00	0.0
Resvr 2	1820	#N/A	-3479.10	1820.00	0.0

Peak Hour Demand

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 3	1600	100.7	302.10	1758.58	68.7
Junc 4	1590	156.1	468.30	1751.26	69.9
Junc 5	1610	102.1	306.30	1755.81	63.2
Junc 6	1610	88.4	265.20	1753.38	62.1
Junc 7	1625	0	0.00	1753.38	55.6
Junc 8	1585	85.4	256.20	1752.20	72.4
Junc 9	1575	103.9	311.70	1749.53	75.6
Junc 10	1615	66.7	200.10	1748.73	57.9
Junc 11	1615	174.4	523.20	1749.92	58.5
Junc 12	1615	43.2	129.60	1752.66	59.6
Junc 13	1625	0	0.00	1748.65	53.6
Junc 14	1620	35.9	107.70	1751.68	57.1
Junc 15	1620	55.4	166.20	1759.41	60.4
Junc 16	1605	144.7	434.10	1747.67	61.8
Junc 17	1595	133.7	401.10	1748.73	66.6
Junc 19	1640	50.2	150.60	1810.08	73.7
Junc 21	1630	5.2	15.60	1811.63	78.7
Junc 22	1640	108.8	326.40	1816.97	76.7
Junc 26	1655	196.9	590.70	1810.11	67.2

Peak Hour Demand

Network Table - Links

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 7	2800	16	120	-1685.88	2.69	1.90	0.023	Open
Pipe 9	2400	12	120	-436.91	1.24	0.63	0.027	Open
Pipe 10	1000	12	100	230.10	0.65	0.27	0.041	Open
Pipe 14	1900	16	120	2200.31	3.51	3.12	0.022	Open
Pipe 15	2200	12	120	360.74	1.02	0.44	0.027	Open
Pipe 16	1400	16	120	-1709.97	2.73	1.96	0.023	Open
Pipe 17	1600	16	120	1013.40	1.62	0.74	0.024	Open
Pipe 22	3400	12	120	173.36	0.49	0.11	0.030	Open
Pipe 23	2000	12	120	1125.77	3.19	3.66	0.023	Open
Pipe 24	2100	12	120	503.29	1.43	0.82	0.026	Open
Pipe 25	2400	12	120	154.17	0.44	0.09	0.031	Open
Pipe 26	2100	12	120	-405.33	1.15	0.55	0.027	Open
Pipe 27	2600	16	120	777.93	1.24	0.45	0.025	Open
Pipe 29	2300	16	120	-364.95	0.58	0.11	0.028	Open
Pipe 30	1200	12	120	-364.95	1.04	0.45	0.027	Open
Pipe 31	3200	16	120	36.15	0.06	0.00	0.039	Open
Pipe 32	1700	12	120	-434.10	1.23	0.63	0.027	Open
Pipe 34	1000	16	120	0.00	0.00	0.00	0.000	Open
Pipe 36	2600	12	120	116.40	0.33	0.05	0.032	Open

Peak Hour Demand

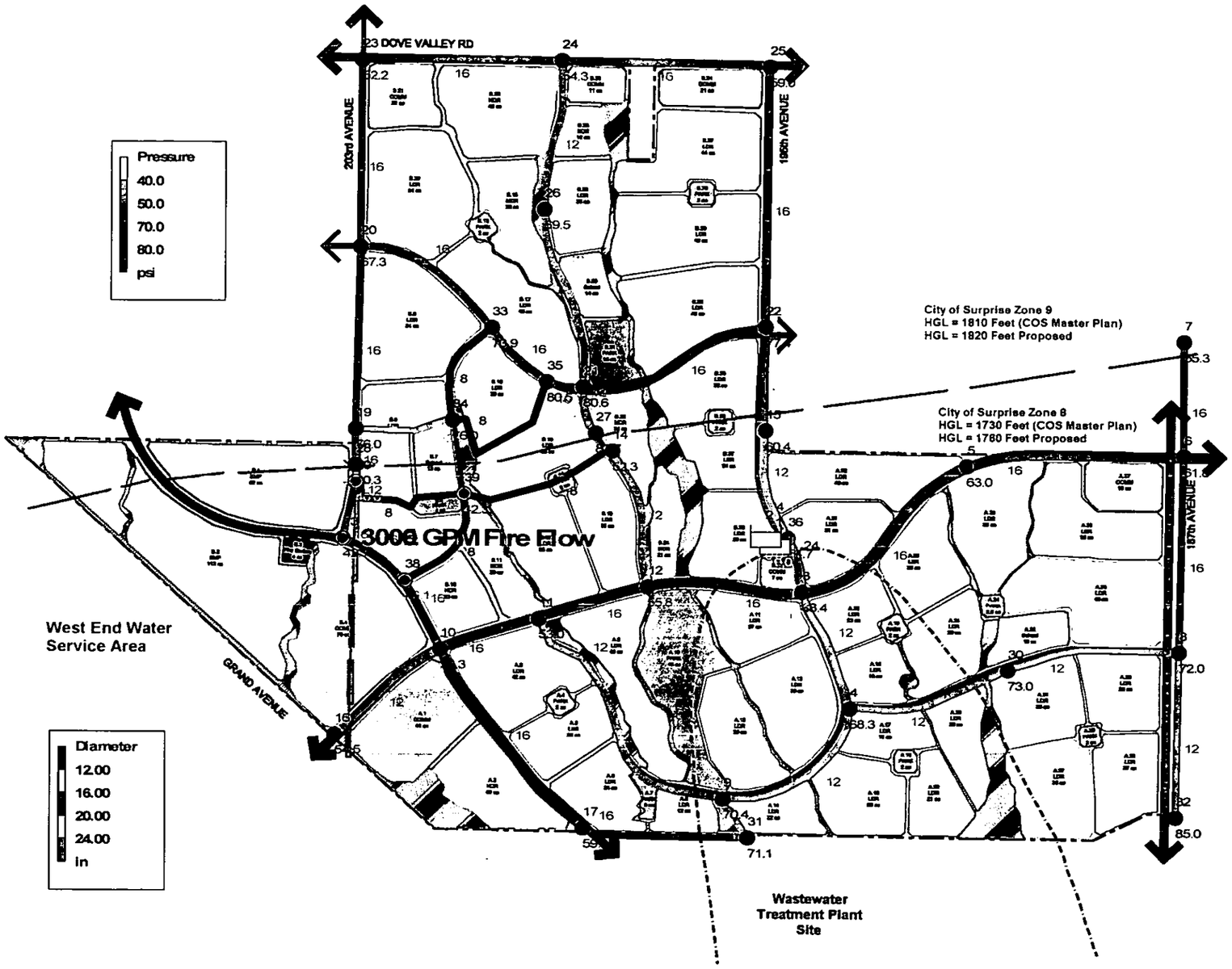
Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 3	500	24	120	4977.60	3.53	1.96	0.020	Open
Pipe 4	200	24	120	5261.10	3.73	2.17	0.020	Open
Pipe 5	3000	24	120	3479.10	2.47	1.01	0.021	Open
Pipe 6	1500	12	120	-166.20	0.47	0.11	0.031	Open
Pipe 8	2200	16	120	1349.43	2.15	1.26	0.023	Open
Pipe 11	3100	16	120	1043.13	1.66	0.78	0.024	Open
Pipe 12	1700	16	120	-558.87	0.89	0.25	0.027	Open
Pipe 13	1000	16	120	-843.83	1.35	0.53	0.025	Open
Pipe 28	700	16	120	-1003.27	1.60	0.73	0.024	Open
Pipe 35	500	16	120	0.00	0.00	0.00	0.000	Open
Pipe 37	1200	12	120	51.80	0.15	0.01	0.036	Open
Pipe 38	1200	8	120	123.86	0.79	0.44	0.030	Open
Pipe 39	1500	8	120	-159.44	1.02	0.71	0.029	Open
Pipe 40	2600	16	120	-202.40	0.32	0.04	0.031	Open
Pipe 41	2600	16	120	28.73	0.05	0.00	0.042	Open
Pipe 42	2600	16	120	-143.63	0.23	0.02	0.033	Open
Pipe 43	1300	12	120	153.79	0.44	0.09	0.031	Open
Pipe 44	2600	16	120	-911.22	1.45	0.61	0.025	Open
Pipe 45	3500	16	120	-1466.82	2.34	1.47	0.023	Open
Pipe 46	1200	8	120	-122.38	0.78	0.43	0.030	Open

Peak Hour Demand

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 47	1500	8	120	-253.04	1.62	1.66	0.027	Open
Pipe 48	1200	8	120	126.46	0.81	0.46	0.030	Open
Pipe 49	1000	16	120	122.38	0.20	0.01	0.033	Open
Pipe 50	1000	16	120	-343.06	0.55	0.10	0.029	Open
Pipe 51	1200	16	120	-122.38	0.20	0.01	0.033	Open
Valve 21	#N/A	12	#N/A	0.00	0.00	0.00	0.000	Closed

Maximum Day Demand plus 3000 gpm fire at Node 13

Day 1, 12:00 AM



Sunhaven

City of Surprise, Arizona

Planned Area Development

Master Water Plan

LEGEND

- Low Density Residential (3-5 du/ac)
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- Commercial
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- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary
- 65 Ldn Line
- Parcel Label:

NORTH

Not To Scale

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8605

Maximum Day Demand plus 3000 gpm fire at Node 13

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 3	1600	100.7	201.40	1757.83	68.4
Junc 4	1590	156.1	312.20	1747.71	68.3
Junc 5	1610	102.1	204.20	1755.31	63.0
Junc 6	1610	88.4	176.80	1752.73	61.8
Junc 7	1625	0	0.00	1752.73	55.3
Junc 8	1585	85.4	170.80	1751.18	72.0
Junc 9	1575	103.9	207.80	1737.57	70.4
Junc 10	1615	66.7	133.40	1731.19	50.3
Junc 11	1615	174.4	348.80	1737.41	53.0
Junc 12	1615	43.2	86.40	1743.87	55.8
Junc 13	1625	1500	3000.00	1722.21	42.1
Junc 14	1620	35.9	71.80	1740.62	52.3
Junc 15	1620	55.4	110.80	1759.28	60.4
Junc 16	1605	144.7	289.40	1730.69	54.5
Junc 17	1595	133.7	267.40	1732.46	59.6
Junc 19	1640	50.2	100.40	1815.32	76.0
Junc 21	1630	5.2	10.40	1816.05	80.6
Junc 22	1640	108.8	217.60	1818.57	77.4
Junc 26	1655	196.9	393.80	1815.33	69.5

Maximum Day Demand plus 3000 gpm fire at Node 13

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 27	1625	76.7	153.40	1815.92	82.7
Junc 28	1630	0	0.00	1815.32	80.3
Junc 29	1630	0	0.00	1722.38	40.0
Junc 30	1580	186.5	373.00	1748.38	73.0
Junc 31	1570	0	0.00	1734.10	71.1
Junc 32	1555	38.8	77.60	1751.11	85.0
Junc 24	1690	204.6	409.20	1815.39	54.3
Junc 25	1680	185.2	370.40	1816.14	59.0
Junc 23	1695	38.3	76.60	1815.37	52.2
Junc 20	1660	128.4	256.80	1815.36	67.3
Junc 33	1645	53.7	107.40	1815.56	73.9
Junc 34	1640	111.7	223.40	1815.31	76.0
Junc 35	1630	0	0.00	1815.81	80.5
Junc 36	1610	39.1	78.20	1759.36	64.7
Junc 38	1620	197.3	394.60	1726.38	46.1
Junc 39	1630	1.4	2.80	1727.57	42.3
Resvr 1	1760	#N/A	-6507.40	1760.00	0.0
Resvr 2	1820	#N/A	-2319.40	1820.00	0.0

Maximum Day Demand plus 3000 gpm fire at Node 13

Network Table - Links

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 7	2800	16	120	-1123.92	1.79	0.90	0.024	Open
Pipe 9	2400	12	120	-291.27	0.83	0.30	0.028	Open
Pipe 10	1000	12	100	153.40	0.44	0.13	0.044	Open
Pipe 14	1900	16	120	3494.89	5.58	7.35	0.020	Open
Pipe 15	2200	12	120	690.04	1.96	1.48	0.025	Open
Pipe 16	1400	16	120	-2718.45	4.34	4.61	0.021	Open
Pipe 17	1600	16	120	2478.08	3.95	3.89	0.021	Open
Pipe 22	3400	12	120	-108.43	0.31	0.05	0.033	Open
Pipe 23	2000	12	120	1340.35	3.80	5.06	0.023	Open
Pipe 24	2100	12	120	1307.51	3.71	4.83	0.023	Open
Pipe 25	2400	12	120	-279.36	0.79	0.28	0.028	Open
Pipe 26	2100	12	120	-652.36	1.85	1.33	0.025	Open
Pipe 27	2600	16	120	900.76	1.44	0.60	0.025	Open
Pipe 29	2300	16	120	-991.28	1.58	0.71	0.024	Open
Pipe 30	1200	12	120	-991.28	2.81	2.89	0.024	Open
Pipe 31	3200	16	120	-723.88	1.16	0.40	0.026	Open
Pipe 32	1700	12	120	-289.40	0.82	0.30	0.028	Open
Pipe 34	1000	16	120	0.00	0.00	0.00	0.000	Open
Pipe 36	2600	12	120	77.60	0.22	0.03	0.034	Open

Maximum Day Demand plus 3000 gpm fire at Node 13

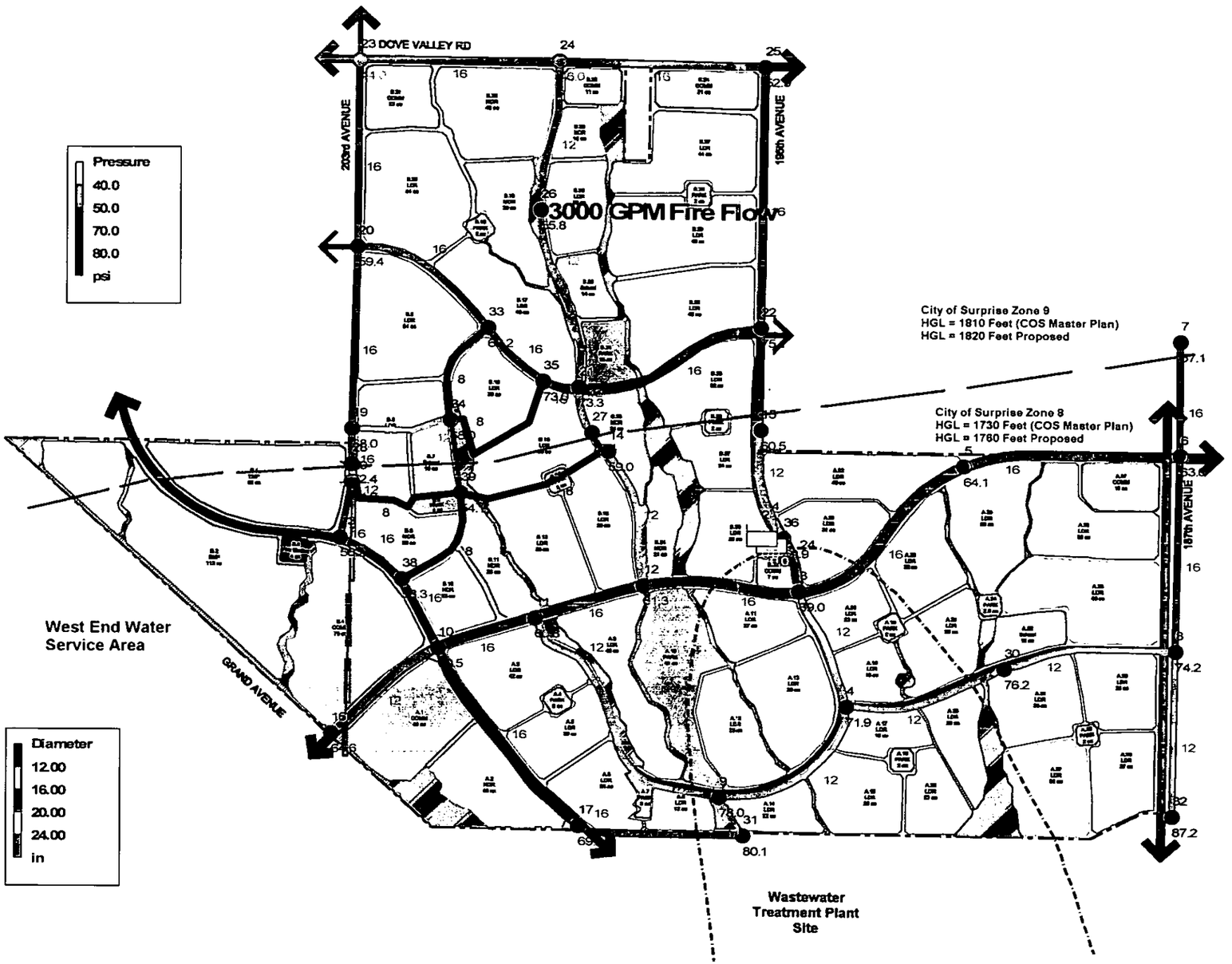
Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 3	500	24	120	6318.40	4.48	3.05	0.020	Open
Pipe 4	200	24	120	6507.40	4.62	3.22	0.019	Open
Pipe 5	3000	24	120	2319.40	1.64	0.48	0.023	Open
Pipe 6	1500	12	120	-110.80	0.31	0.05	0.033	Open
Pipe 8	2200	16	120	1281.76	2.05	1.15	0.024	Open
Pipe 11	3100	16	120	1077.56	1.72	0.83	0.024	Open
Pipe 12	1700	16	120	-372.58	0.59	0.12	0.028	Open
Pipe 13	1000	16	120	-562.56	0.90	0.25	0.027	Open
Pipe 28	700	16	120	-668.85	1.07	0.34	0.026	Open
Pipe 35	500	16	120	0.00	0.00	0.00	0.000	Open
Pipe 37	1200	12	120	34.53	0.10	0.01	0.038	Open
Pipe 38	1200	8	120	82.58	0.53	0.21	0.032	Open
Pipe 39	1500	8	120	-106.29	0.68	0.33	0.031	Open
Pipe 40	2600	16	120	-134.94	0.22	0.02	0.033	Open
Pipe 41	2600	16	120	19.15	0.03	0.00	0.043	Open
Pipe 42	2600	16	120	-95.75	0.15	0.01	0.035	Open
Pipe 43	1300	12	120	102.53	0.29	0.04	0.033	Open
Pipe 44	2600	16	120	-607.48	0.97	0.29	0.026	Open
Pipe 45	3500	16	120	-977.88	1.56	0.69	0.024	Open
Pipe 46	1200	8	120	-423.99	2.71	4.32	0.025	Open

Maximum Day Demand plus 3000 gpm fire at Node 13

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 47	1500	8	120	-618.24	3.95	8.69	0.024	Open
Pipe 48	1200	8	120	191.45	1.22	0.99	0.029	Open
Pipe 49	1000	16	120	-2576.00	4.11	4.18	0.021	Open
Pipe 50	1000	16	120	-2779.16	4.43	4.81	0.021	Open
Pipe 51	1200	16	120	-424.00	0.68	0.15	0.028	Open
Valve 21	#N/A	12	#N/A	0.00	0.00	0.00	0.000	Closed

Maximum Day Demand plus 3000 gpm fire at Node 26

Day 1, 12:00 AM



Sunhaven

City of Surprise, Arizona

Planned Area Development

Master Water Plan

LEGEND

- Low Density Residential (0-5 du/ac)
- Medium Density Residential (5-8 du/ac)
- High Density Residential (15-21 du/ac)
- Commerical
- Park/Open Space
- Multi Use/ Employment
- School
- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary
- 65 Ldn Line
- Parcel Label:

NORTH

Not To Scale

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ. 85016
Phone: (602)954-0038
Fax: (602)944-8505

EPANET 2

Maximum Day Demand plus 3000 gpm fire at Node 26

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 3	1600	100.7	201.40	1759.33	69.0
Junc 4	1590	156.1	312.20	1755.88	71.9
Junc 5	1610	102.1	204.20	1758.02	64.1
Junc 6	1610	88.4	176.80	1756.88	63.6
Junc 7	1625	0	0.00	1756.88	57.1
Junc 8	1585	85.4	170.80	1756.32	74.2
Junc 9	1575	103.9	207.80	1755.06	78.0
Junc 10	1615	66.7	133.40	1754.68	60.5
Junc 11	1615	174.4	348.80	1755.24	60.8
Junc 12	1615	43.2	86.40	1756.54	61.3
Junc 13	1625	0	0.00	1754.64	56.2
Junc 14	1620	35.9	71.80	1756.07	59.0
Junc 15	1620	55.4	110.80	1759.72	60.5
Junc 16	1605	144.7	289.40	1754.18	64.6
Junc 17	1595	133.7	267.40	1754.68	69.2
Junc 19	1640	50.2	100.40	1796.98	68.0
Junc 21	1630	5.2	10.40	1799.11	73.3
Junc 22	1640	108.8	217.60	1813.34	75.1
Junc 26	1655	1696.9	3393.80	1783.84	55.8

Maximum Day Demand plus 3000 gpm fire at Node 26

Node ID	Elevation ft	Base Demand GPM	Demand GPM	Head ft	Pressure psi
Junc 27	1625	76.7	153.40	1798.98	75.4
Junc 28	1630	0	0.00	1796.98	72.4
Junc 29	1630	0	0.00	1754.65	54.0
Junc 30	1580	186.5	373.00	1755.77	76.2
Junc 31	1570	0	0.00	1754.80	80.1
Junc 32	1555	38.8	77.60	1756.25	87.2
Junc 24	1690	204.6	409.20	1796.09	46.0
Junc 25	1680	185.2	370.40	1802.08	52.9
Junc 23	1695	38.3	76.60	1796.47	44.0
Junc 20	1660	128.4	256.80	1796.98	59.4
Junc 33	1645	53.7	107.40	1797.70	66.2
Junc 34	1640	111.7	223.40	1797.03	68.0
Junc 35	1630	0	0.00	1798.42	73.0
Junc 36	1610	39.1	78.20	1759.79	64.9
Junc 38	1620	197.3	394.60	1754.64	58.3
Junc 39	1630	1.4	2.80	1754.90	54.1
Resvr 1	1760	#N/A	-3507.40	1760.00	0.0
Resvr 2	1820	#N/A	-5319.40	1820.00	0.0

Maximum Day Demand plus 3000 gpm fire at Node 26

Network Table - Links

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 7	2800	16	120	-2863.93	4.57	5.08	0.021	Open
Pipe 9	2400	12	120	-1517.59	4.31	6.36	0.022	Open
Pipe 10	1000	12	100	153.40	0.44	0.13	0.044	Open
Pipe 14	1900	16	120	1466.87	2.34	1.47	0.023	Open
Pipe 15	2200	12	120	240.49	0.68	0.21	0.029	Open
Pipe 16	1400	16	120	-1139.98	1.82	0.92	0.024	Open
Pipe 17	1600	16	120	675.60	1.08	0.35	0.026	Open
Pipe 22	3400	12	120	115.57	0.33	0.05	0.032	Open
Pipe 23	2000	12	120	750.51	2.13	1.73	0.025	Open
Pipe 24	2100	12	120	335.53	0.95	0.39	0.028	Open
Pipe 25	2400	12	120	102.78	0.29	0.04	0.033	Open
Pipe 26	2100	12	120	-270.22	0.77	0.26	0.029	Open
Pipe 27	2600	16	120	518.62	0.83	0.21	0.027	Open
Pipe 29	2300	16	120	-243.30	0.39	0.05	0.030	Open
Pipe 30	1200	12	120	-243.30	0.69	0.21	0.029	Open
Pipe 31	3200	16	120	24.10	0.04	0.00	0.042	Open
Pipe 32	1700	12	120	-289.40	0.82	0.30	0.028	Open
Pipe 34	1000	16	120	0.00	0.00	0.00	0.000	Open
Pipe 36	2600	12	120	77.60	0.22	0.03	0.034	Open

Maximum Day Demand plus 3000 gpm fire at Node 26

Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 3	500	24	120	3318.40	2.35	0.93	0.022	Open
Pipe 4	200	24	120	3507.40	2.49	1.03	0.021	Open
Pipe 5	3000	24	120	5319.40	3.77	2.22	0.020	Open
Pipe 6	1500	12	120	-110.80	0.31	0.05	0.033	Open
Pipe 8	2200	16	120	899.62	1.44	0.60	0.025	Open
Pipe 11	3100	16	120	695.42	1.11	0.37	0.026	Open
Pipe 12	1700	16	120	-749.93	1.20	0.42	0.025	Open
Pipe 13	1000	16	120	-997.83	1.59	0.72	0.024	Open
Pipe 28	700	16	120	-1182.54	1.89	0.99	0.024	Open
Pipe 35	500	16	120	0.00	0.00	0.00	0.000	Open
Pipe 37	1200	12	120	-101.81	0.29	0.04	0.033	Open
Pipe 38	1200	8	120	140.50	0.90	0.56	0.030	Open
Pipe 39	1500	8	120	-184.71	1.18	0.93	0.029	Open
Pipe 40	2600	16	120	1.41	0.00	0.00	0.000	Open
Pipe 41	2600	16	120	-494.54	0.79	0.20	0.027	Open
Pipe 42	2600	16	120	417.94	0.67	0.14	0.028	Open
Pipe 43	1300	12	120	1876.21	5.32	9.43	0.021	Open
Pipe 44	2600	16	120	-1867.47	2.98	2.30	0.022	Open
Pipe 45	3500	16	120	-2237.87	3.57	3.22	0.022	Open
Pipe 46	1200	8	120	-81.59	0.52	0.20	0.032	Open

Maximum Day Demand plus 3000 gpm fire at Node 26

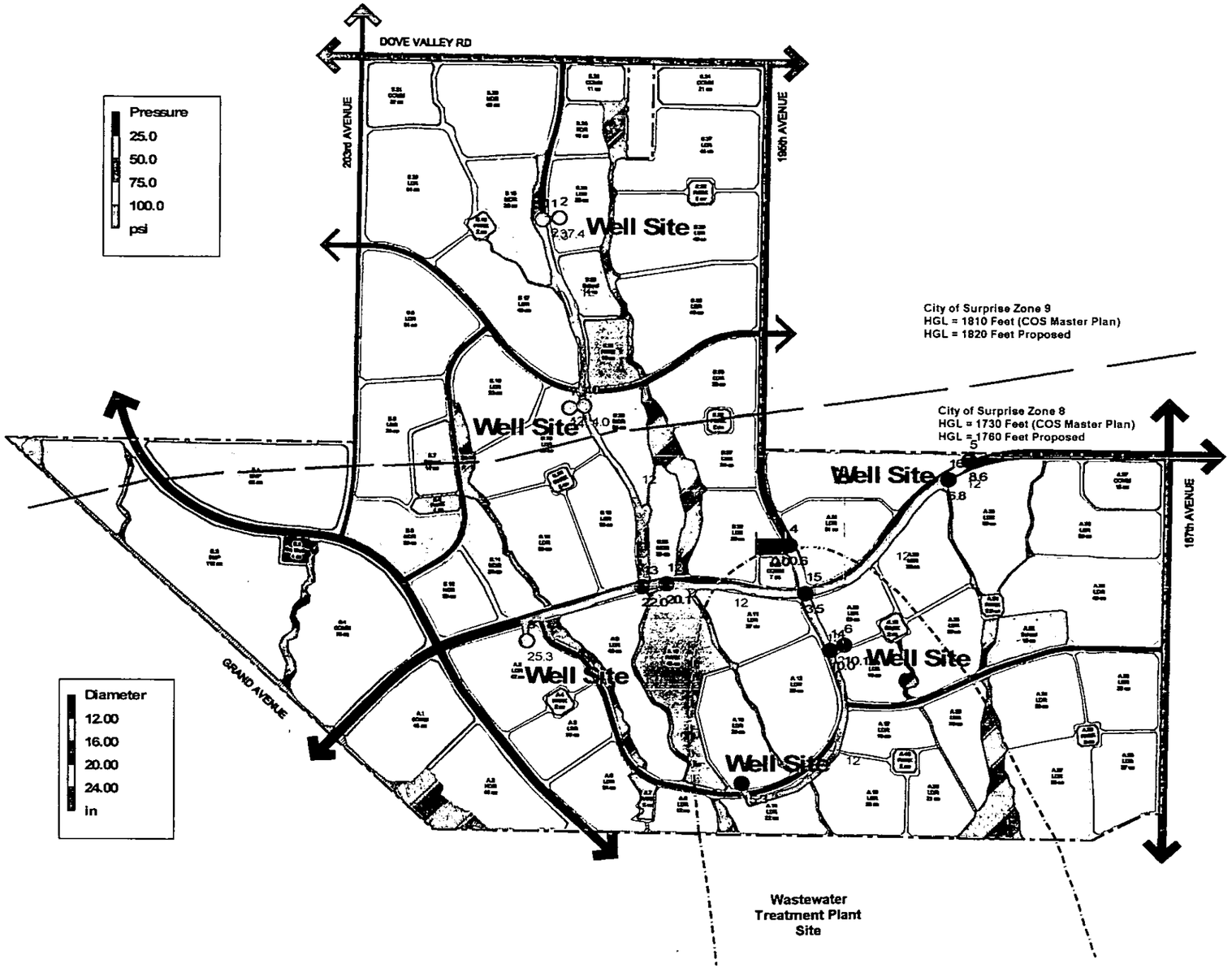
Link ID	Length ft	Diameter in	Roughness	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Friction Factor	Status
Pipe 47	1500	8	120	-168.69	1.08	0.78	0.029	Open
Pipe 48	1200	8	120	84.31	0.54	0.22	0.032	Open
Pipe 49	1000	16	120	81.59	0.13	0.01	0.035	Open
Pipe 50	1000	16	120	-228.71	0.36	0.05	0.030	Open
Pipe 51	1200	16	120	-81.59	0.13	0.01	0.036	Open
Valve 21	#N/A	12	#N/A	0.00	0.00	0.00	0.000	Closed

APPENDIX B

SUNHAVEN
WATER WELL DELIVERY LINE OPTIONS

Potential Well Locations

Day 1, 12:00 AM



Sunhaven

City of Surprise, Arizona

Planned Area Development

Master Water Plan

Proposed Well Locations

LEGEND

- Low Density Residential (3-5 du/ac)
- Medium Density Residential (5-8 du/ac)
- High Density Residential (15-21 du/ac)
- Commercial
- Park/Open Space
- Multi Use/ Employment
- School
- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary
- 65 Ldn Line
- Parcel Label: Master Parcel Number, Land Use Designation, Gross Acreage

NORTH

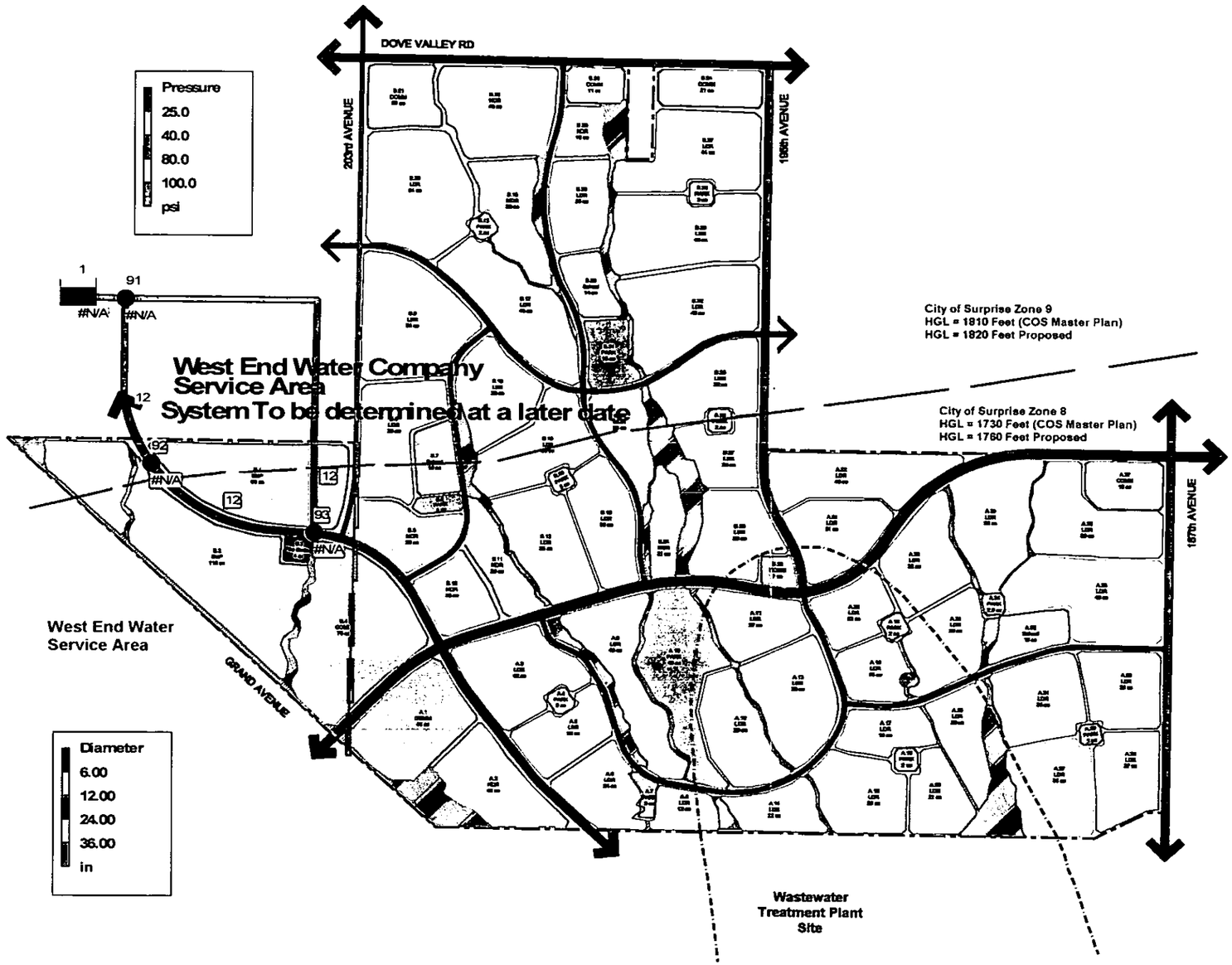
Not To Scale

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ. 85016
Phone: (602)954-0038
Fax: (602)944-8505

APPENDIX C

SUNHAVEN
WEST END WATER COMPANY SERVICE AREA
POSSIBLE WATER SYSTEM

West End Water Company Service Area Future Lines



Sunhaven

City of Surprise, Arizona

Planned Area Development

Master Water Plan

LEGEND

- Low Density Residential (3-5 du/ac)
- Medium Density Residential (5-8 du/ac)
- High Density Residential (15-21 du/ac)
- Commercial
- Park/Open Space
- Multi Use/ Employment
- School
- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary
- 65 Ldn Line
- Parcel Label:

NORTH

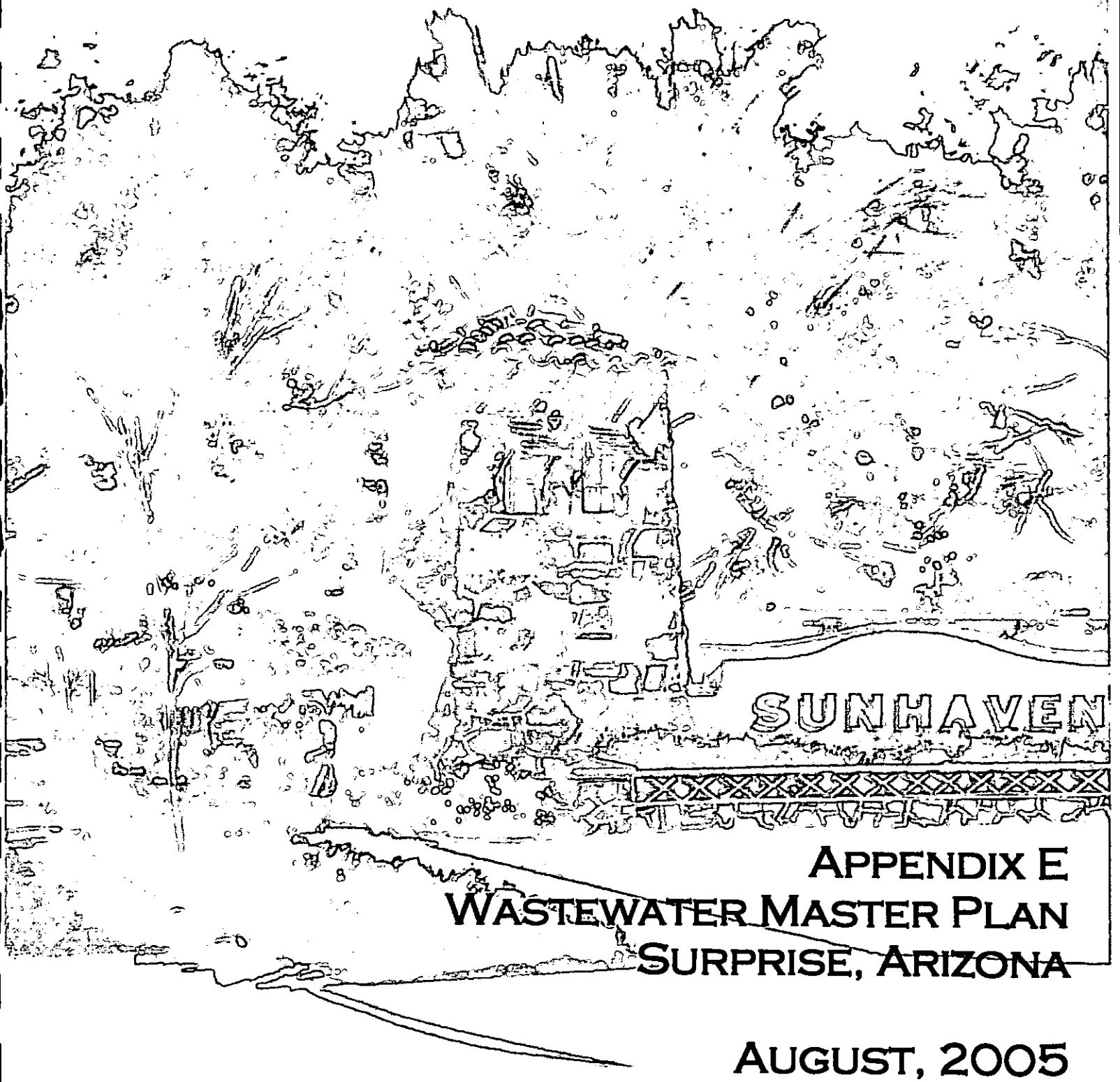
Not To Scale

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8605

EPANET 2

SUNHAVEN - PAD

A MASTER PLANNED COMMUNITY



APPENDIX E
WASTEWATER MASTER PLAN
SURPRISE, ARIZONA

AUGUST, 2005

REVISED SUBMITTAL – DECEMBER, 2005

Concept Wastewater Master Plan
For
Sunhaven
Surprise, Arizona

Prepared for

Sunhaven I, LLC
c/o Mike Jesberger
426 North 44th Street, Suite 240
Phoenix, AZ 85008

602-286-0000

Prepared By

DEI Professional Services
6225 N. 24th Street, Suite 200
Phoenix, Arizona 85016
(602) 954-0038

RECEIVED
DEC 21 2005
COMMUNITY DEVELOPMENT

December 16, 2005

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1.0 Executive Summary

Sunhaven consists of approximately 2,120 acres of a proposed Planned Area Development. Sunhaven is located in the planning area of the City of Surprise in the northwest portion of the Phoenix Metropolitan area of Maricopa County. It is the intent of the owner to request annexation into the City of Surprise prior to the approval of the Planned Area Development action by the City. The project is located in portions of Sections 17, 19, 20, and 21, Township 5 North, Range 2 West of the Gila-Salt River Base and Meridian. The property lies north of the Central Arizona Project Canal and east of Highway 60.

This report has been prepared to aid with the master planning of the project. It is expected that this report will be adjusted over time to reflect the changes in planning concepts that may occur during the master planning process.

The property lies within Special Planning Area 4 (SPA4) of the sewer service area of the City of Surprise. A sewer collection service system connected to a package wastewater treatment plant located on the south end of the project has been analyzed to serve the development. While the City plans to eventually construct a regional wastewater treatment plant to service the entire area of SPA4, it can not be constructed in the time frames necessary to construct this project.

A sewer collection system will be designed and constructed to serve the needs of 8,001 units for Sunhaven. The wastewater generation rate of 100 gallons per day has been used as a basis for sizing the system. It should be noted that ADEQ has reduced the per capita flow generation rate to 80 gallons per day as of November 2005. We have conferred with Mr. Steven Borst of Maricopa County Department of Environmental Services and have been told that MCESD also intends to adopt the lower flow generation standards. However, as the City of Surprise IWMP is based upon the 100 gpcpd standard, this standard has been used within this concept master sewer plan. It is expected that future editions of this master plan will utilize the 80 gpcpd level after it is also adopted by the City.

Based upon a population estimate of 3.2 capita for low density residential dwelling units and 2.0 capita for medium/high density residential units for each of the expected 8,001 residential units, a total population of 21,722 is expected. In addition, a sewer flow of 2,500 gallons per day was estimated for each acre of proposed commercial and employment development. This density of dwelling units over the property is based upon the City of Surprise General Plan for the area and the levels proposed by the developer within the Sunhaven Master Planned Community Planned Area Development document. The facilities will be sized based upon the peak flow.

The generated flows will be directed to a proposed wastewater treatment plant. The proposed site for the wastewater plant is on private land south of the property. The plant will use Sequencing Batch Reactor technology and treat the water to unlimited reuse standards. The plant design report will be prepared by others.

The high quality effluent from the wastewater treatment plant will be used as irrigation water for the parks and open space within the project and also to recharge underground aquifers.

2.0 Introduction

Sunhaven consists of approximately 2,120 of a proposed Planned Area Development. Sunhaven is located in the planning area of the City of Surprise in the northwest portion of the Phoenix Metropolitan area of Maricopa County. It is the intent of the owner to request annexation into the City of Surprise prior to the approval of the Planned Area Development action by the City. The project is located in portions of Sections 17, 19, 20, and 21, Township 5 North, Range 2 West of the Gila-Salt River Base and Meridian. The property lies north of the Central Arizona Project Canal and east of Highway 60. Please refer to the Vicinity map **(FIGURE 1)**.

The development, upon completion will be accessed from 203rd Avenue and eventually from the future extension of Dove Valley Road, 195th Avenue, Tillman Drive, and 187th Avenue.

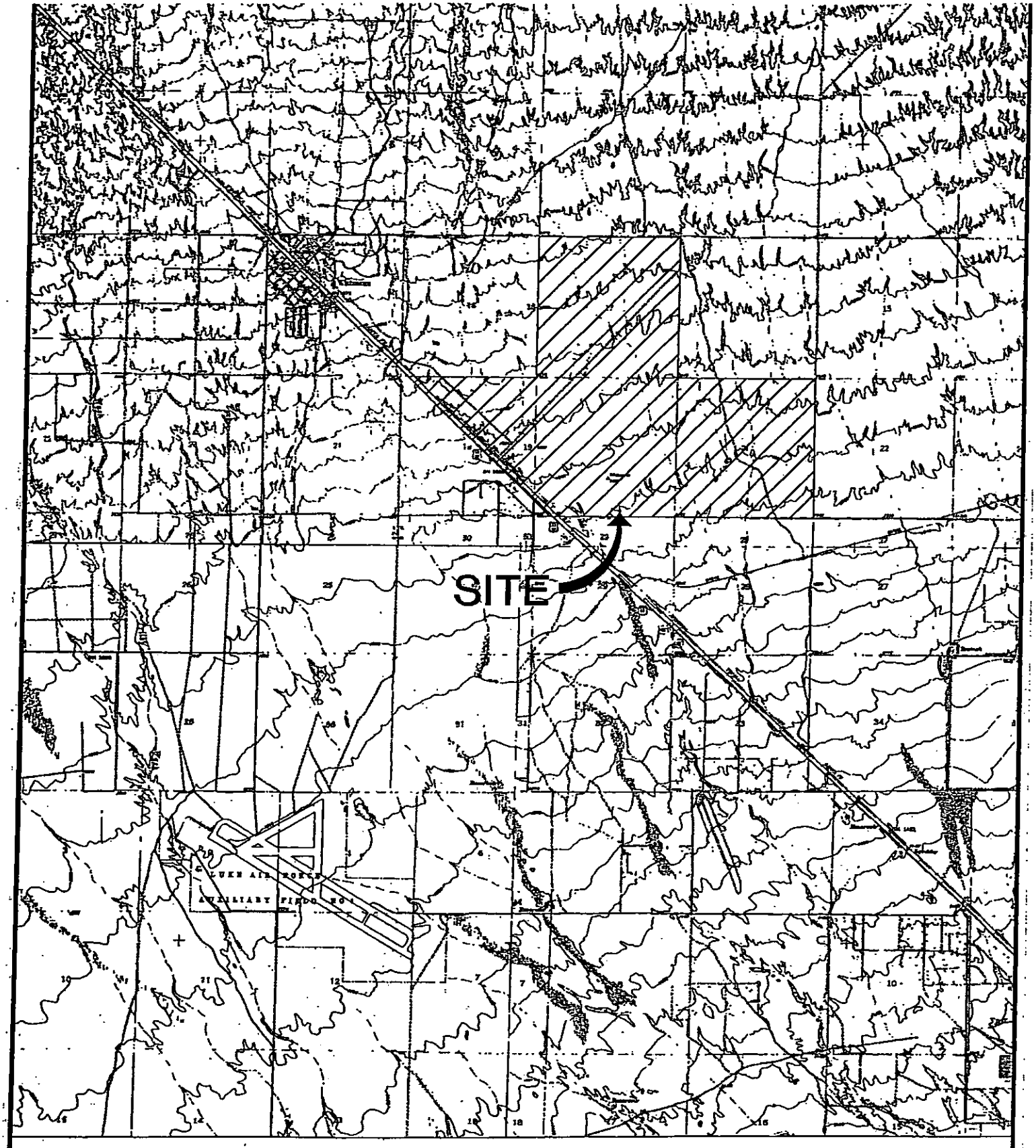
The subject property is within the certificated area for sewer service of the City of Surprise. There are currently no services in the area. The wastewater collection system will be sized for the ultimate build-out of approximately 8,001 residential units with 3.2 residents per unit for low and suburban density units and 2.0 people per residence for medium and high-density residential units. A value of 100 gallons per resident per day was used to yield an Average Day Flow (ADD) of 3.28 million gallons of wastewater flow generated per day on the Sunhaven Property. This flow includes allowances for commercial properties that will be developed with the rest of the property.

Pease note that the Arizona Department of Environmental Quality has reduced the per capita flow generation rate from 100 to 80 gallons per day as of November 2005. We have conferred with Mr. Steven Borst of Maricopa County Department of Environmental Services and have been told that MCESD also intends to adopt the lower flow generation standards. However, as the City of Surprise IWMP is currently based upon the 100 gpcpd standard, this standard has been used within this concept master sewer plan. It is expected that future editions of this master plan will utilize the 80 gpcpd level after it is also adopted by the City.

In addition, the City of Surprise prepared the City of Surprise Water Resources Master Plan in June 2004. This report shows planned infrastructure requirements that will ultimately be necessary to convey flows through SPA4 to the future regional wastewater treatment plant. This report has included the flow rates identified within that report and have routed the flows through the Sunhaven through an increase in the collection system sizes. Proposed sewer collection systems have been calculated for both a stand alone and City of Surprise IWMP based flows.

2.1 Scope of Work

The purpose of this report is to study and determine the wastewater collection system requirements for the proposed Sunhaven (2,120-acre) development. This report has been prepared to aid with the master planning of the project. It is expected that this report will



MAP REFERENCES:

7.5 MINUTE QUADRANGLE MAP
WHITE TANKS MTS. NE., ARIZ.
PHOTOREVISED 1971

7.5 MINUTE QUADRANGLE MAP
WITTMANN., ARIZ.
PHOTOREVISED 1981

7.5 MINUTE QUADRANGLE MAP
HIEROGLYPHIC MTS. SW., ARIZ.
PHOTOREVISED 1981

7.5 MINUTE QUADRANGLE MAP
MCMICKEN DAM, ARIZ.
PHOTOREVISED 1981

1982 - 2005
23
YEARS OF EXCELLENCE
DEI Professional Services, L.L.C.

DEI Professional Services, LLC
6225 N. 24th Street, Suite 200
Phoenix, Arizona 85016
Phone: (602) 954-0038
Fax: (602) 944-4605

SUNHAVEN

VICINITY MAP

FIGURE 1

DATE: 05/10/05 | PROJ. NO: 04043 | SCALE: 1"=5000' | CAD FILE: 04043V01

TABLE 1
Sewer System Demands
By Parcel and Phase - Commercial at 2,500 gallons per acre per day

Area	Land Use	Gross Area[Ac]	Net Area[Ac]	Density [Du/Ac]	Target Total Density Units	EDU's	Population	Unit Demand (gpcd)	Average Day Demand (gpd)	Assign to Node
Phase 1										
A1	COMM	45.5	35.8	-	-	356	-	2500	113,811	30
A2	HDR	45.3	28.2	15-21	424	265	847	100	84,738	18
A3	LDR	41.7	32.6	3-5	187	187	600	100	59,988	4
A4	PARK	2.0	1.8	3-5	-	-	-	250	499	4
A5	LDR	24.7	19.4	3-5	111	111	356	100	35,609	4
A6	LDR	24.3	19.7	3-5	79	79	253	100	25,274	3
A7	PARK	3.4	2.2	3-5	-	-	-	250	852	3
A8	LDR	12.1	9.4	3-5	45	45	145	100	14,490	3
A9	LDR	47.9	30.7	3-5	144	144	460	100	46,015	3
A10	PARK	43.1	36.5	3-5	-	-	-	500	21,555	2
A11	LDR	27.1	20.5	3-5	88	88	282	100	28,215	25
A12	LDR	28.6	24.3	3-5	100	100	320	100	32,039	2
A13	LDR	39.0	33.0	3-5	140	140	449	100	44,911	23
A14	LDR	21.5	14.5	3-5	65	65	207	100	20,677	2
A15	LDR	29.0	25.3	3-5	87	87	278	100	27,828	23
A16	PARK	2.0	1.8	3-5	-	-	-	250	499	23
A17	LDR	18.2	14.3	3-5	77	77	248	100	24,795	24
A18	LDR	18.2	14.0	3-5	68	68	218	100	21,849	25
A19	PARK	2.0	1.9	3-5	-	-	-	250	499	25
A20	LDR	22.8	15.7	3-5	69	69	219	100	21,929	25
A21	LDR	30.8	24.9	3-5	92	92	296	100	29,555	26
A22	LDR	40.4	32.3	3-5	151	151	485	100	48,465	26
A23	LDR	32.2	25.7	3-5	97	97	309	100	30,903	32
A24	LDR	29.1	23.5	3-5	90	90	289	100	28,862	32
A25	LDR	27.6	17.9	3-5	83	83	265	100	26,454	32
A26	LDR	20.7	16.1	3-5	62	62	199	100	19,869	35
A27	LDR	35.9	27.5	1-3	75	75	241	100	24,113	36
A28	LDR	26.6	21.6	3-5	109	109	349	100	34,905	36
A29	PARK	2.0	1.5	3-5	-	-	-	250	499	36
A30	LDR	27.7	22.2	3-5	104	104	332	100	33,187	36
A31	LDR	32.9	26.9	3-5	99	99	316	100	31,582	32
A32	SCHOOL	15.9	11.5	3-5	1200	-	-	35	42,000	32
A33	LDR	48.9	41.3	1-3	134	134	430	100	43,021	33
A34	PARK	2.0	1.7	3-5	-	-	-	250	499	32
A35	LDR	38.3	32.0	1-3	115	115	368	100	36,768	32
A36	LDR	38.2	32.3	3-5	157	157	502	100	50,152	32
A37	COMM	18.8	14.0	-	-	147	-	2500	46,990	32
Phase 1	**TOTAL**	**986.4**	**754.6**		**3,053**	**3,397**	**9,262**		**1,153,899**	

Area	Land Use	Gross Area[Ac]	Net Area[Ac]	Density [Du/Ac]	Target Total Density Units	EDU's	Population	Unit Demand (gpcd)	Average Day Demand (gpd)	Assign to Node
Phase 2										
B1	EMP	65.6	59.8		-	513	-	2500	164,048	9
B2	EMP	110.7	82.6		-	865	-	2500	276,750	9
B3	PUBLIC USE	2.5	2.1		-	20	-	2500	6,250	9
B4	COMM	75.6	62.0		-	591	-	2500	189,106	6
B5	HDR	25.9	22.6	21	466	291	932	100	93,200	6
B6	PARK	3.9	3.2		-	-	-	250	975	40
B7	SCHOOL	13.4	12.3		1200	-	-	35	42,000	40
B8	LDR	35.4	32.7	5	141	141	451	100	45,120	7
B9	LDR	53.5	50.0	5	186	186	595	100	59,520	40
B10	HDR	23.5	20.9	21	422	264	844	100	84,400	8
B11	HDR	19.9	15.7	21	358	224	716	100	71,600	4
B12	LDR	35.3	31.7	5	123	123	394	100	39,360	11
B13	LDR	30.4	27.9	5	99	99	317	100	31,680	11
B14	PARK	2.0	2.0		-	-	-	250	499	12
B15	LDR	35.2	31.6	5	127	127	407	100	40,704	12
B16	LDR	33.0	27.6	5	138	138	443	100	44,262	40
B17	LDR	45.8	39.5	5	149	149	477	100	47,680	15
B18	MDR	30.0	22.0	8	180	113	360	100	36,000	13
B19	PARK	2.0	2.0		-	-	-	250	499	15
B20	LDR	53.8	51.3	5	175	175	560	100	56,000	15
B21	COMM	22.0	18.9		-	172	-	2500	55,085	15
B22	HDR	46.2	38.4	21	831	519	1662	100	166,200	14
B23	COMM	11.5	8.5		-	90	-	2500	28,697	14
B24	COMM	20.9	18.3		-	163	-	2500	52,196	16
B25	HDR	15.8	11.2	21	284	178	568	100	56,800	14
B26	LDR	25.0	22.9	5	88	88	282	100	28,160	14
B27	MDR	43.7	41.7	8	262	262	838	100	83,840	16
B28	PARK	2.0	2.0		-	-	-	250	499	16
B29	LDR	47.8	42.9	5	155	155	496	100	49,600	16
B30	SCHOOL	14.0	11.8		1200	-	-	35	42,000	13
B31	PARK	15.1	12.5		-	-	-	250	3,776	13
B32	LDR	49.1	44.9	5	197	197	630	100	63,040	16
B33	MDR	23.7	17.3	8	142	89	284	100	28,410	12
B34	MDR	21.1	10.9	8	127	79	254	100	25,400	17
B35	LDR	32.0	28.0	5	109	109	349	100	34,880	26
B36	PARK	2.0	2.0		-	-	-	250	499	26
B37	LDR	24.3	19.2	5	78	78	250	100	24,960	26
B38	LDR	32.9	26.6	5	110	110	352	100	35,200	120
B39	COMM	6.6	4.7		-	52	-	2500	16,551	120
Phase 2	**TOTAL**	**1153.1**	**981.9**		**4,948**	**6,358**	**12,460**		**2,125,448**	

Sun Haven	**TOTAL**	**2120**	**1737**		**8,001**	**9,755**	**21,722**		**3,279,347**	

be adjusted over time to reflect the changes in planning concepts that may occur during the master planning. The wastewater collection system will be designed to meet the guidelines established by the City of Surprise, Maricopa County, and State of Arizona Regulations (AAC R18-9-E301). Maricopa County and the City of Surprise will review and approve the collection system and its associated components at various stages of the development process.

The concepts proposed include a stand-alone system and a system designed such that it will be compatible with future adjacent facilities proposed for Special Planning Area 4.

2.2 Topographic Conditions

The property is undeveloped and appears to have been used for ranching in the past. Native desert vegetation covers the site. The natural slope of the land is from north to south at approximately 1.0 percent. The Atchison Topeka and Santa Fe Railroad right of way forms the southwest boundary of the property. The slope along this right of way is from the northwest to the southeast at approximately 0.75 percent.

The high point on the Sunhaven property is approximately elevation 1695 at the northwest corner. And the lowest point of the property is elevation 1550 at the southeastern corner of the property. This represents an average slope of 0.95 percent across the property.

3.0 Existing Collection System

There are no existing collection systems in the area that will affect or be used by this development.

4.0 Collection System Design Criteria

The wastewater collection system for Sunhaven has been developed based upon the anticipated flows generated from the development units on the property. Sewage flows in local gravity sewers convey the flows to the main collection sewer from each of the development areas. **FIGURE 2** shows the collection system that will service the development areas within Sunhaven.

The gravity sewer system has been sized according to the following criteria:

- Number of Dwelling Units - Proposed 8,001 Units
- Residents per Unit - 3.2 people per LDR and SR units
  2.0 people per unit MDR and HDR units
- Average Daily Flow - 100 gallons per capita per day
- Manhole spacing - 500' maximum
- Manning's Roughness - 0.013
- Pipeline material - SDR35 PVC sewer pipe

- Minimum Radius for Curves 287' for 12.5' lay lengths
  458' for 20' lay lengths
- Velocity - 2.0 fps minimum at peak flow

4.1 Proposed Land Use

The Land use described in the Sunhaven Master Planned Community Planned Area Development documents have been used to establish the expected densities and sewer flows from the property. For master planning purposes maximum density lot allowance (8,001 units) has been used to evaluate the line sizes required to serve the property. As the master planning effort proceeds, the adjustment in the units to be developed should be reflected in updates to this report.

Land uses and densities shown on the Land Use Plan by LVA Urban Design Studio on August 1, 2005 has been used for the Sunhaven project.

4.2 Design Population

TABLE 1 lists the planned development areas and expected number of units at full buildout. An allowance of 2,500 gallons per acre per day Average Day Demand has been included for the commercial areas based upon the City of Surprise Water Infrastructure Master Plan criteria. These areas have been converted to Equivalent Dwelling Units (EDU's). The table also includes the expected population, average sewage flow, and expected peak flow rates. Based upon a population estimate of 3.2 capita per dwelling unit for each of the expected low density residential units and a population estimate of 2.0 capita per dwelling unit for the medium and high density residential units, a total population of approximately 21,722 is expected.

5.0 Wastewater Facilities

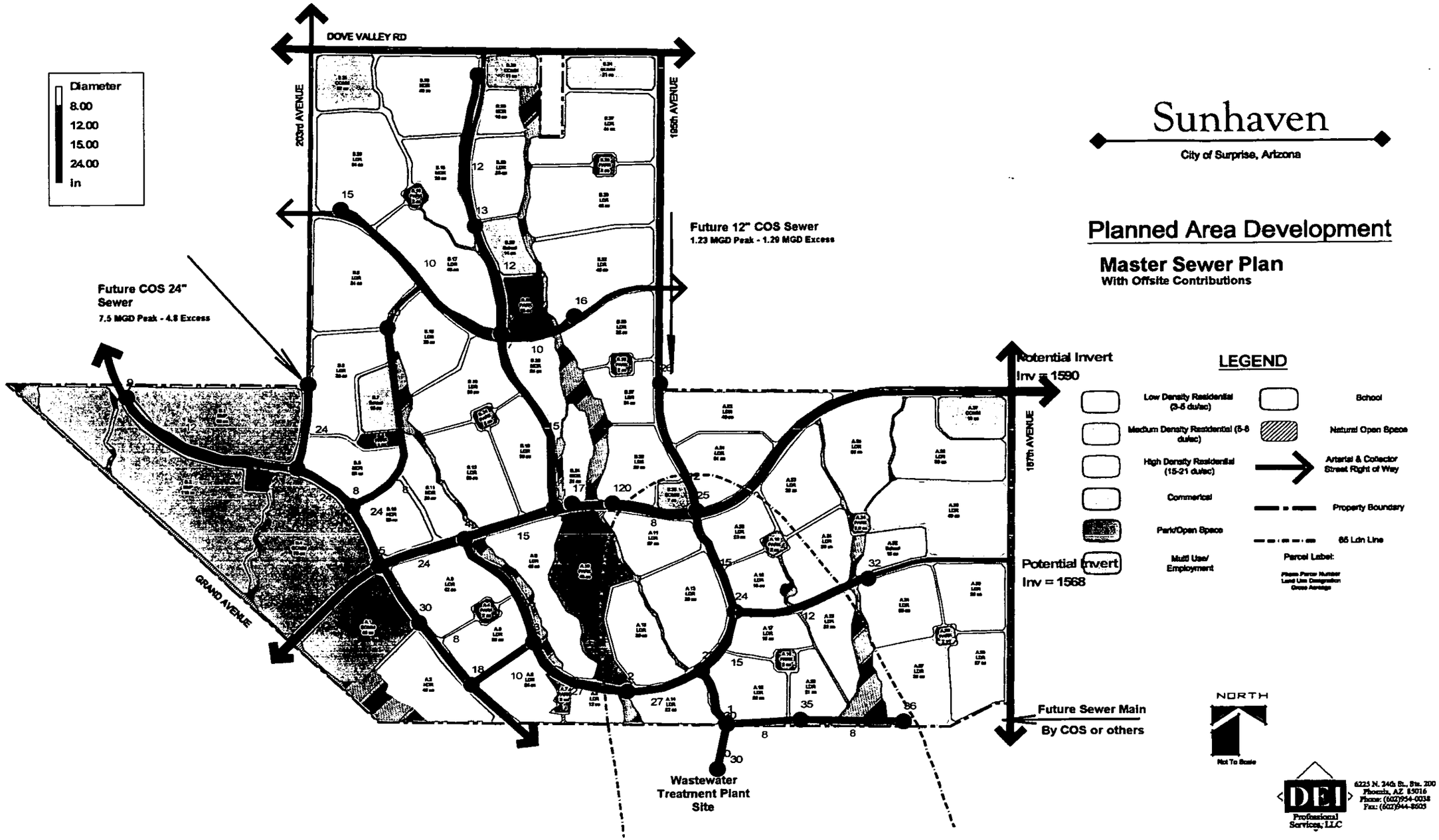
5.1 Existing Facilities

No facilities currently exist.

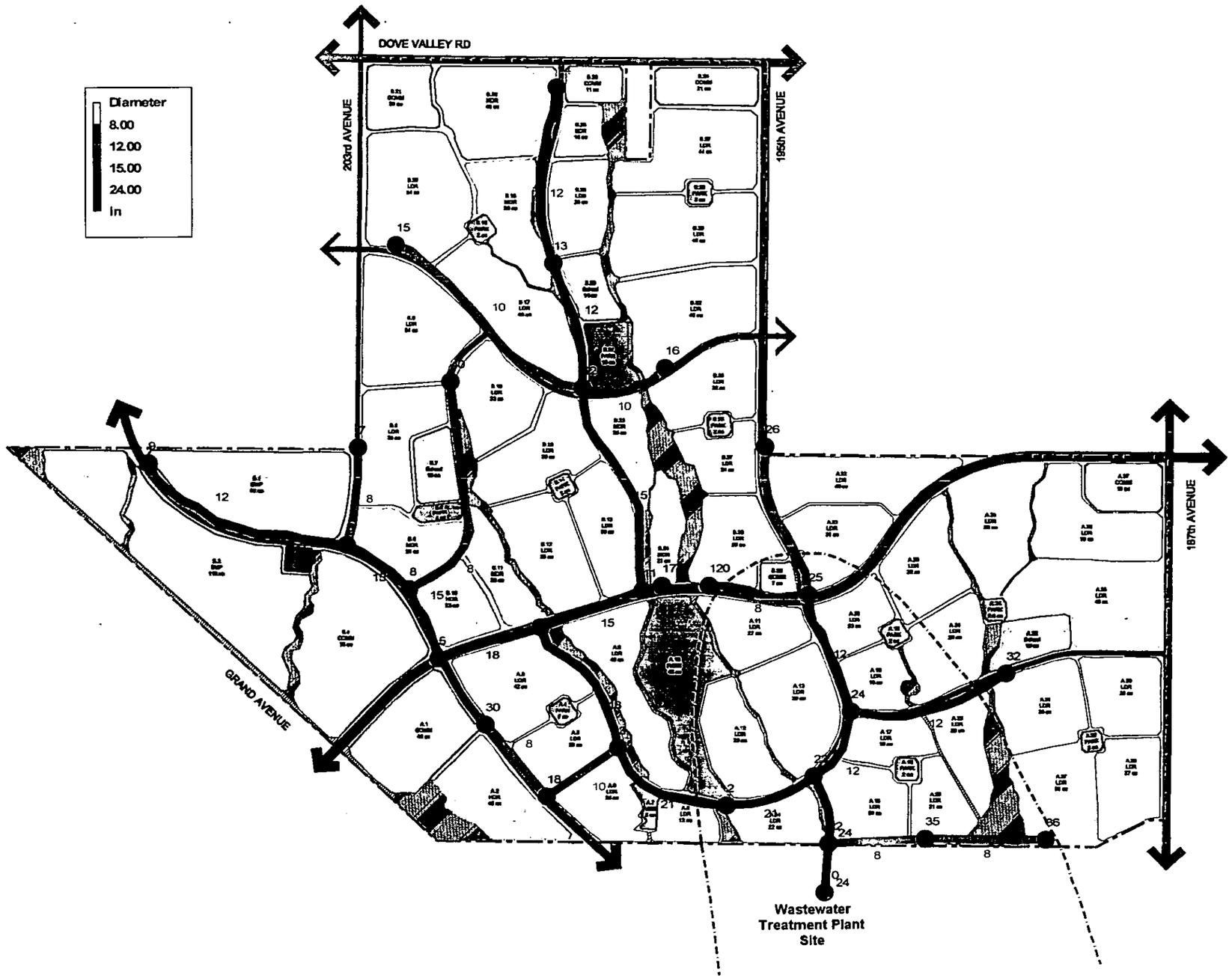
5.2 Proposed Facilities

Each of the proposed development areas within the property will have an internal gravity sewer collection system that will convey flows to the interceptor sewers shown in **FIGURE 2**. The interceptor sewer will direct the collected flows to the south boundary of the property where the collection main will convey the flows to the new wastewater treatment plant site.

A new wastewater treatment plant using Sequencing Batch Reactor Technology is proposed to service the site. The plant is currently planned to have a capacity to handle


Diameter
8.00
12.00
15.00
24.00
in
DOVE VALLEY RD
205th AVENUE
195th AVENUE
157th AVENUE
GRAND AVENUE
Future COS 24" Sewer
7.5 MGD Peak - 4.8 Excess
Future 12" COS Sewer
1.23 MGD Peak - 1.20 MGD Excess
Potential Invert
Inv = 1590
Potential Invert
Inv = 1568
Future Sewer Main
By COS or others
Wastewater Treatment Plant Site
Sunhaven
City of Surprise, Arizona
Planned Area Development
Master Sewer Plan
With Offsite Contributions
LEGEND
Low Density Residential (3-5 du/ac)
Medium Density Residential (5-8 du/ac)
High Density Residential (15-21 du/ac)
Commerical
Park/Open Space
Multi Use/ Employment
School
Natural Open Space
Arterial & Collector Street Right of Way
Property Boundary
65 Ldn Line
Parcel Label:
NORTH
Not To Scale
DEI
Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ. 85016
Phone: (602)954-0038
Fax: (602)944-8035

EPANET 2



Sunhaven

City of Surprise, Arizona

Planned Area Development

Master Sewer Plan

With No Offsite Contributions

LEGEND

- Low Density Residential (3-5 du/ac)
- Medium Density Residential (5-8 du/ac)
- High Density Residential (15-21 du/ac)
- Commerical
- Park/Open Space
- Multi Use/ Employment
- School
- Natural Open Space
- Arterial & Collector Street Right of Way
- Property Boundary
- 65 Ldn Line
- Parcel Label:
  - Phase Parcel Number
  - Land Use Designation
  - Gross Acreage

NORTH

Not To Scale

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8505

the flows from the property. The plant will treat the water to an unlimited water reuse standard. It is planned that a combination of open space irrigation and recharge will be used to handle the effluent from the plant.

The actual design of the plant will be included in a separate design report / master plan.

6.0 Wastewater System Design Criteria

A daily residential wastewater flow of 100 gallons per capita per day was used for sizing the sewer lines within the study area. A population estimate of 3.2 capita per dwelling unit for each of the expected low density and suburban residential units and a population estimate of 2.0 capita per dwelling unit for the medium and high density residential units, a total population of approximately 21,722 is expected for Sunhaven.

A value of 2,500 gallons per acre per day was used to evaluate the Average Day sewage flow from the commercial properties on the site. This value is based upon 4.26 EDU's per gross acre of commercial property. A value of 250 gallons per acre per day was used for park areas.

6.1 Peaking Factor

A peaking factor of 2.5 was used on all sewers 12 inches in diameter and greater and 4.0 for 8 and 10 inch diameter sewers. This was used in lieu of the population based peaking factor within ADEQ's Aquifer Protection Permit Criteria. Table 2 shows a comparison of potential peaking factor equations that could be used for this project.

TABLE 2
Peaking Factor Comparison

Pop	Pop /1000	ADEQ	Arizona American	This Report
100	0	3.62	3.0	4.0
200	0	3.14	3.0	4.0
300	0	2.90	3.0	4.0
400	0	2.74	3.0	4.0
500	1	2.64	3.0	4.0
600	1	2.56	3.0	4.0
700	1	2.50	3.0	4.0
800	1	2.46	3.0	4.0
900	1	2.42	3.0	4.0
1000	1	2.38	3.0	4.0
5000	5	1.98	3.0	2.5
10001	10	1.85	3.0	2.5
50000	50	1.62	3.0	2.5

Pop = Upstream population

Pop/ 1000 = population in 1000's of people

Arizona American = peaking factor in manual of 3.0

This Report = 2.5 peaking factor used in master plan for Pipes 12" and greater, 4.0 peaking factor used for 8" and 10" pipes, approx.1000 people

ADEQ = Peaking Factor from Title 18, Environmental Quality, Chapter 9, Department of Environmental Quality Water Pollution Control, R18-9-301. 4.01 (D) Design Requirements

The line sizing related to this analysis is shown in **TABLE 4.**

6.2 Design Slope

The system has been designed to flow by gravity and takes maximum advantage of the topographic constraints. Contributing areas were routed in a generally southern direction. The lines were sized using slopes between 0.2 and 0.60 percent for pipes 12 inches in diameter and greater. Table 4 and 4A reflect the minimum slopes that can be used to convey the ultimate flow for that area through the pipe reach. Steeper slopes may be used. In the event a shallower slope is required, a re-evaluation of pipe size will be required. Minimum slopes were used to achieve a 2.0 fps velocity at half or full flow, as shown in the Arizona Department of Environmental Quality Bulletin 11 or AAC R18-9-E301. A maximum depth over diameter ratio of 80 percent was also used to determine the minimum slope and size sewer main.

In order to maintain a minimum self-cleansing velocity of 2 feet per second, with a Manning's roughness factor of 0.013, the following minimum slopes were used:

- 8-inch sewers – minimum slope of 0.0033 ft/ft (.0035 used in analysis)
- 12-inch sewers –minimum slope of 0.0022 ft/ft (COS design criteria)
- 15-inch sewers –minimum slope of 0.0014 ft/ft (.002 used in analysis)
- 18-inch sewers –minimum slope of 0.0011 ft/ft (.002 used in analysis)

No sewer should be installed at a slope of less than 0.001 ft/ft in order to control grade.

7.0 Model Results

The flows generated within each development area are shown in **TABLE 1.** These flows were allocated to various manhole locations within the collection system and are shown in **TABLE 3.** The results of the wastewater gravity collection analysis are shown in **TABLE 4.** Average daily flows from each contributing areas were calculated based on planning development numbers.

Offsite areas to Sunhaven have been included as average day flow rates and are shown in **TABLE 4.** These flows have been routed through the Sunhaven system to the outfall point on the south.

An analysis has also been performed with Sunhaven as a "stand alone" system with no allowance for flows entering from offsite. The sizes need to convey the flows through Sunhaven are shown in **TABLE 4A.** The difference in size represents the upsizing of the Sunhaven system that will be required to assist the City with the conveyance of flows from other properties.

Average daily flows from each contributing area arriving at a collection point were totaled together. The peaking factor was applied to the Average Daily Flow value to determine the design value. The peak flow was then compared to the calculated allowable capacity in each sewer main. Excess sewer capacity in each line was also calculated.

8.0 Summary

A sewer service plan has been prepared for master planning purposes. This concept master plan has utilized current planning data for Sunhaven. Using this planning data and generally accepted flow estimates, a projection of sewage flow rates has been prepared for both Average Day and Peak Flow.

A sewage collection system has been sized within Sunhaven that will accept peak flows expected following ultimate buildout of the project and the contributing areas in SPA4.

A "stand alone" system has also been calculated. The "stand alone" system does not consider flows from outside the development as part of the sewer system sizing.

The combined flows will be directed to a proposed wastewater treatment plant. The proposed site for the wastewater plant is on the south side of the project. The plant will use Sequencing Batch Reactor technology and treat the water to unlimited reuse standards. The plant design report will be prepared by others.

The high quality effluent from the wastewater treatment plant will be used as irrigation water for the parks and open space within the project and also to recharge underground aquifers.

TABLE 3

Flows and Contributing Areas at Manholes

Sunhaven Ranch - Commercial at 2,500 gpad

MH No.	Contrib. Pipes from MH	Contrib. Area	Gross Area (Ac)	Pop.	Area EDU's	Area Avg Day Flow [gpd]
Offsite A						3,000,000
Offsite B						492,000
1	2, 21		-	-	-	-
2	3	A10,A12,A14	93.3	527	165	74,271
3	4, 18	A6, A7, A8, A9	87.7	858	268	86,631
4	5,11	A3, A4, A5, B11	88.3	1672	522	167,697
5	8					
6	7,9	B4, B5	101.5	932	882	282,306
7	Offsite A	B8	35.4	452	141	45,197
8	6,40	B10	23.5	844	264	84,400
9	None	B1, B2, B3	178.8	0	1397	447,048
10	1					
11	12,17	B12, B13	65.7	710	222	71,040
12	13,15,16	B14, B15, B33	60.9	691	216	69,550
13	14	B18, B30, B31	59.0	360	112	81,746
14	None	B22, B23, B25, B26	98.5	2511	874	279,823
15	None	B17, B19, B20, B21	123.7	1037	496	159,265
16	None	B24, B27, B28, B29, B32	163.5	1964	777	249,084
17	None	B34	21.1	254	79	25,400
18	30	A2	45.3	847	265	84,738
21	22		-	-	-	-
22	23, 35		-	-	-	-
23	24	A13,A15, A16	70.0	727	227	73,238
24	25, 32	A17	18.2	248	77	24,795
25	26, 120	A11, A18, A19, A20	70.2	720	225	72,492
26	Offsite B	A21, A22, B35, B36, B37	129.5	1379	431	138,360
30	None	A1	45.5	0	356	113,811
32	None	A23, A24, A25, A31, A32, A33, A34, A35, A36, A37	283.9	2477	921	337,232
35	36	A26	20.7	199	62	19,869
36	None	A27, A28, A29, A30	92.1	922	288	92,704
40	None	B6, B7, B9, B16	103.9	1037	324	146,705
120	None	B38, B39	39.5	352	162	51,751
TOTAL			**2119.5**	**21,720**	**9,755**	**3,279,154**

TABLE 4

SUNHAVEN PIPE and WASTEWATER FLOW SUMMARY

Sewer Inverts based upon 10' starting depth

12/19/2005

Manhole No.	Contrib. Pipes	Contib. Area	Area (ac)	Land Use	Density (du/ac)	Proposed Number of E.D. Units	Equivalent Population (capita)	Ave. Flow (gpd)	Ave. Flow (gpm)	Ave. Flow Contrib. Pipe (gpd)	Total Ave. Flow (gpd)	Total Ave. Flow (gpm)	Peaking Factor	Peak Flow1 (gpd)	Peak Flow1 (gpm)	Pipe Size	Area Sq Ft	Min Slope (ft/ft)	K'	Depth to Diameter Ratio (D/d)	Velocity at Peak Flow	Length	to MH	Original Proposed Invert Elev.	Proposed Nat. Gnd. Elev.	Adjusted Invert	Depth at Adjusted Invert	Full Capacity (gpd)	Excess Capacity (gpd)
Offsite A							-	3,002,800	2085	0	3,002,800	2085.3	2.5	7,507,000	5,213	24	3.14	0.003	0.4342	0.77	3.9							7,985,295	478,295
Offsite B							-	492,000	342	-	492,000	341.7	2.5	1,230,000	854	12	0.79	0.003	0.4517	0.80	2.5							1,254,703	24,703
14	None	B22, B23, B25, B26	98.5	M/HDR (ASANTE)	8.3	874.4	2,511	279,823	194.3	-	279,823	194.3	2.5	699,558	485.8	12	0.79	0.0022	0.3000	0.59	2.1	2600	13	1665.0	1682.0	1672.0	10.0	1,074,463	374,906
13	14	B18, B30, B31	59.0	LDR, M/HDR, PP/F	Varies	112.4	360	81,748	56.8	279,823	361,569	251.1	2.5	903,923	627.7	12	0.79	0.0022	0.3877	0.70	2.1	1900	12	1633.0	1650.0	1640.0	10.0	1,074,463	170,541
15	None	B17, B19, B20, B21	123.7	LDR, M/HDR	Varies	496.1	1,037	159,265	110.6	-	159,265	110.6	4.0	637,058	442.4	10	0.55	0.0030	0.3804	0.69	2.2	3500	12	1647.0	1667.0	1657.0	10.0	771,129	134,071
16	None	B24, B27, B28, B29, B32	163.5	LDR, M/HDR	Varies	776.8	1,964	249,084	173.0	-	249,084	173.0	4.0	996,338	691.9	10	0.55	0.0055	0.4394	0.78	3.0	1300	12	1619.0	1635.0	1625.0	10.0	1,044,113	47,776
12	13,15,16	B14, B15, B33	60.9	M/HDR	8.3	215.8	691	69,550	48.3	769,918	839,468	583.0	2.5	2,098,670	1457.4	15	1.23	0.0030	0.4251	0.75	2.9	2750	11	1612.0	1635.0	1617.5	17.5	2,276,620	177,951
17	None	B34	21.1	LDR,M/HDR, PP/F, ES	Varies	79.4	254	25,400	17.6	-	25,400	17.6	4.0	101,600	70.6	8	0.35	0.0035	0.1019	0.31	2.0	400	11	1587.0	1605.0	1595.0	10.0	459,040	357,440
11	12, 17	B12, B13	65.7	LDR	3.8	222.0	710	71,040	49.3	839,468	910,508	632.3	2.5	2,276,270	1580.7	15	1.23	0.0035	0.4268	0.76	3.1	1350	4	1585.5	1602.5	1593.5	9.0	2,459,031	182,761
7	Offsite A	B8	35.4			141.2	452	45,197	31.4	3,002,800	3,047,997	2,116.7	2.5	7,619,992	5291.7	24	3.14	0.0030	0.4407	0.78	3.9	1400	6	1620.0	1637.0	1622.0	15.0	7,985,295	365,303
9	None	B1, B2, B3	178.8	Commercial, M/HDR	varies	1397.0	0	447,048	310.5	-	447,048	310.5	2.5	1,117,620	776.1	12	0.79	0.0030	0.4105	0.73	2.5	3200	6	1629.0	1645.0	1635.0	10.0	1,254,703	137,083
6	7,9	B4, B5	101.5	M/HDR, Commercial	varies	882.2	932	282,308	196.0	3,495,045	3,777,351	2,623.2	2.5	9,443,378	6557.9	24	3.14	0.0050	0.4231	0.75	5.1	950	8	1609.0	1625.0	1615.0	10.0	10,308,972	865,594
40	None	B6, B7, B9, B16	103.9			324.2	1037	146,705	101.9	-	146,705	101.9	4.0	586,821	407.5	8	0.35	0.0060	0.4493	0.80	2.7	3225	8	1625.0	1642.0	1632.0	10.0	601,025	14,203
8	6, 40	B11, B13	23.5	LDR	3.8	263.8	844	84,400	58.6	3,924,057	4,008,457	2,783.7	2.5	10,021,142	6959.1	24	3.14	0.0050	0.4490	0.80	5.1	1000	5	1602.0	1617.0	1607.0	10.0	10,308,972	287,830
5	8		0.0			0.0	0	-	0.0	4,008,457	4,008,457	2,783.7	2.5	10,021,142	6959.1	24	3.14	0.0050	0.4490	0.80	5.1	1380	4	1585.0	1605.0	1595.0	10.0	10,308,972	287,830
4	5, 11	A3, A4, A5, B11	88.3			522.5	1672	167,897	116.5	4,918,965	5,086,861	3,532.4	2.5	12,716,654	8831.0	27	3.97	0.0045	0.4387	0.78	5.2	1400	3	1578.0	1605.0	1587.8	17.2	13,394,109	677,456
30	None	A1	45.5			355.7	0	113,811	79.0	-	113,811	79.0	4.0	455,245	316.1	8	0.35	0.0040	0.4268	0.76	2.2	1400	18	1579.0	1595.0	1578.0	17.0	490,735	35,490
18	30	A2	45.3			264.8	847	84,738	58.8	113,811	198,549	137.9	4.0	794,198	551.5	10	0.55	0.0035	0.4391	0.78	2.4	1400	3	1567.0	1584.0	1572.1	12.0	832,914	38,717
3	4, 18	A6,A7, A8, A9	87.7			268.1	858	86,631	60.2	5,285,211	5,371,842	3,730.4	2.5	13,429,604	9326.1	27	3.97	0.0050	0.4395	0.78	5.5	1250	2	1560.0	1577.0	1566.8	10.2	14,118,631	689,027
2	3	A10,A12,A14	93.3			164.7	527	74,271	51.6	5,371,842	5,446,112	3,782.0	2.5	13,615,281	9455.1	27	3.97	0.0050	0.4456	0.79	5.5	1000	23	1556.0	1575.0	1560.2	14.8	14,118,631	503,350
26	Offsite B	A21, A22, B35, B36,B37	129.5			430.8	1379	138,360	96.1	492,000	630,360	437.7	2.5	1,575,899	1094.4	12	0.79	0.0055	0.4274	0.76	3.3	2100	25	1602.0	1620.0	1605.0	15.0	1,698,876	122,976
120	None	B38, B39	39.5			161.7	352	51,751	35.9		51,751	35.9	4.0	207,004	143.8	8	0.35	0.0035	0.2075	0.47	2.0	1400	25	1588.0	1604.0	1594.0	10.0	459,040	252,036
25	26, 120	A11, A18, A19, A20	70.2			225.0	720	72,492	50.3	682,111	754,603	524.0	2.5	1,886,507	1310.1	15	1.23	0.0025	0.4186	0.75	2.6	1650	24	1580.0	1597.0	1587.0	10.0	2,078,261	191,754
32	None	A23, A24, A25, A31, A32, A33, A34, A35, A36, A37	283.9			921.0	2477	337,232	234.2		337,232	234.2	2.5	843,079	585.5	12	0.79	0.0022	0.3616	0.67	2.1	2100	24	1556.0	1580.0	1570.0	10.0	1,074,463	231,384
24	25, 32	A17	16.2			77.5	248	24,795	17.2	1,091,835	1,116,630	775.4	2.5	2,791,575	1938.6	15	1.23	0.0050	0.4380	0.78	3.7	1200	23	1546.0	1580.0	1564.9	15.1	2,939,104	147,530
23	2, 24	A13,A15, A16	70.0			227.3	727	73,238	50.9	6,562,742	6,635,980	4,608.3	2.5	16,589,951	11520.8	30	4.91	0.0045	0.4321	0.77	5.6	850	-1	1540.0	1572.0	1558.6	13.4	17,745,422	1,155,471
38	None	A27, A28, A29, A30	92.1			288.1	922	92,704	64.4		92,704	64.4	4.0	370,817	257.5	8	0.35	0.0035	0.3717	0.68	2.0	1550	35	1543.0	1560.0	1548.0	12.0	459,040	88,223
35	38	A26	20.7			62.1	199	19,869	13.8	92,704	112,573	78.2	4.0	450,293	312.7	8	0.35	0.0040	0.4223	0.75	2.2	1300	1	1536.8	1560.0	1542.2	17.8	490,735	40,442
1	23, 35	None	-			-	-	-	0.0	6,748,554	6,748,554	4,686.5	2.5	16,871,384	11716.2	30	4.91	0.0045	0.4394	0.78	5.6	700	10	1531.0	1565.0	1536.7	28.3	17,745,422	874,038
10 (PLANT)	1	None	-			-	-	-	0.0	6,748,554	6,748,554	4,686.5	2.5	16,871,384	11716.2	36	7.07	0.0016	0.4532	0.80	3.8	0		1525.0	1555.0	1533.3	21.7	17,216,862	345,478

1. Peaking Factor = 4.0 for 8 & 10-inch pipes, 2.5 for 12-inch and larger
2. Design Criteria - 100 gpcpd with 3.2 people per LDR and SR unit, 2.0 people per MDR and HDR unit
3. Commercial property at 2,500 gallons per acre per day, Park and Public Facility at 250 gallons per acre per day
4. Design slope used ranges from greater of minimum slope or 0.2 percent to maximum of 0.60 percent slope
5. Schools estimated at 35 gallons per day per student

0.013 mannings n value used for all sewers

Table 4A
Pipe and Wastewater Flow Summary for Sunhaven Ranch
No Offsite Contributing Flows

Manhole No.	Contrib. Pipes	Contrib. Area	Area (ac)	Proposed Number of E.D. Units	Equivalent Population (capita)	Ave. Flow (gpd)	Ave. Flow (gpm)	Ave. Flow Contrib. Pipe (gpd)	Total Ave. Flow (gpd)	Total Ave. Flow (gpm)	Peaking Factor	Peak Flow1 (gpd)	Peak Flow1 (gpm)	Pipe Size	Area Sq Ft	Min Slope (ft/ft)	K*	Depth to Diameter Ratio (D/d)	Velocity at Peak Flow	Length	to MH	Original Proposed Invert Elev.	Proposed Nat. Gnd. Elev.	Adjusted Invert	Depth at Adjusted Invert	Full Capacity (gpd)	Excess Capacity (gpd)
Offsite A					-	3,002,800	2085	0	3,002,800	2085.3	2.5	7,507,000	5,213		0.00	0.003											0	
Offsite B					-	492,000	342	-	492,000	341.7	2.5	1,230,000	854		0.00	0.003											0	
14	None	B22, B23, B25, B26	98.5	874.4	2,511	279,823	194.3	-	279,823	194.3	2.5	699,558	485.8	12	0.79	0.0022	0.3000	0.59	2.1	2600	13	1665.0	1682.0	1672.0	10.0	1,074,463	374,906
13	14	B18, B30, B31	59.0	112.4	360	81,746	56.8	279,823	361,569	251.1	2.5	903,923	627.7	12	0.79	0.0022	0.3877	0.70	2.1	1900	12	1633.0	1650.0	1640.0	10.0	1,074,463	170,541
15	None	B17, B19, B20, B21	123.7	498.1	1,037	159,265	110.6	-	159,265	110.6	4.0	637,058	442.4	10	0.55	0.0030	0.3804	0.69	2.2	3500	12	1647.0	1667.0	1657.0	10.0	771,129	134,071
16	None	B24, B27, B28, B29, B32	163.5	776.8	1,964	249,084	173.0	-	249,084	173.0	4.0	996,338	691.9	10	0.55	0.0055	0.4394	0.78	3.0	1300	12	1619.0	1635.0	1625.0	10.0	1,044,113	47,776
12	13,15,16	B14, B15, B33	60.9	215.8	691	69,550	48.3	769,918	839,468	583.0	2.5	2,098,670	1457.4	15	1.23	0.0030	0.4251	0.75	2.9	2750	11	1612.0	1635.0	1617.5	17.5	2,276,820	177,951
17	None	B34	21.1	79.4	254	25,400	17.6	-	25,400	17.6	4.0	101,600	70.6	8	0.35	0.0035	0.1016	0.31	2.0	400	11	1587.0	1605.0	1595.0	10.0	459,040	357,440
11	12, 17	B12, B13	65.7	222.0	710	71,040	49.3	839,468	910,508	632.3	2.5	2,276,270	1580.7	15	1.23	0.0035	0.4268	0.76	3.1	1350	4	1585.5	1602.5	1593.5	9.0	2,459,031	182,761
7	Offsite A	B8	35.4	141.2	452	45,197	31.4	-	45,197	31.4	4.0	180,788	125.5	8	0.35	0.0350	0.0573	0.24	6.4	1400	6	1620.0	1637.0	1622.0	15.0	1,451,612	1,270,825
9	None	B1, B2, B3	178.8	1397.0	0	447,048	310.5	-	447,048	310.5	2.5	1,117,620	776.1	12	0.79	0.0030	0.4105	0.73	2.5	3200	6	1629.0	1645.0	1635.0	10.0	1,254,703	137,083
6	7,9	B4, B5	101.5	882.2	932	282,308	196.0	492,245	774,551	537.9	2.5	1,936,378	1344.7	15	1.23	0.0025	0.4297	0.76	2.6	950	8	1609.0	1625.0	1615.0	10.0	2,078,261	141,882
40	None	B6, B7, B9, B16	103.9	324.2	1037	146,705	101.9	-	146,705	101.9	4.0	586,821	407.5	8	0.35	0.0060	0.4493	0.80	2.7	3225	8	1625.0	1642.0	1632.0	10.0	601,025	14,203
8	6, 40	B11, B13	23.5	283.8	844	84,400	58.6	921,257	1,005,657	698.4	2.5	2,514,142	1745.9	15	1.23	0.0040	0.4410	0.78	3.3	1000	5	1602.0	1617.0	1607.0	10.0	2,628,815	114,673
5	8		0.0	0.0	0	-	0.0	1,005,657	1,005,657	698.4	2.5	2,514,142	1745.9	15	1.23	0.0040	0.4410	0.78	3.3	1380	4	1585.0	1605.0	1595.0	10.0	2,628,815	114,673
4	5, 11	A3, A4, A5, B11	88.3	522.5	1672	167,897	116.5	1,916,165	2,083,861	1,447.1	2.5	5,209,654	3617.8	18	1.77	0.0065	0.4406	0.78	4.8	1400	3	1578.0	1605.0	1589.1	15.9	5,452,562	242,908
30	None	A1	45.5	355.7	0	113,811	79.0	-	113,811	79.0	4.0	455,245	316.1	8	0.35	0.0040	0.4268	0.78	2.2	1400	18	1579.0	1595.0	1578.0	17.0	490,735	35,490
18	30	A2	45.3	264.8	847	84,738	58.8	113,811	198,549	137.9	4.0	794,198	551.5	10	0.55	0.0035	0.4391	0.78	2.4	1400	3	1567.0	1584.0	1572.1	12.0	832,914	38,717
3	4, 18	A8,A7, A8, A9	87.7	268.1	858	86,631	60.2	2,282,411	2,369,042	1,645.2	2.5	5,922,604	4112.9	21	2.40	0.0035	0.4528	0.80	3.9	1250	2	1560.0	1577.0	1566.8	10.2	6,038,456	115,852
2	3	A10,A12,A14	93.3	164.7	527	74,271	51.6	2,369,042	2,443,312	1,696.7	2.5	6,108,281	4241.9	21	2.40	0.0040	0.4368	0.78	4.2	1000	23	1556.0	1575.0	1562.1	12.9	6,455,380	347,100
26	Offsite B	A21, A22, B35, B36,B37	129.5	430.8	1379	138,360	96.1	-	138,360	96.1	4.0	553,439	384.3	8	0.35	0.0055	0.4426	0.78	2.6	2100	25	1602.0	1620.0	1605.0	15.0	575,437	21,998
120	None	B38, B39	39.5	161.7	352	51,751	35.9		51,751	35.9	4.0	207,004	143.8	8	0.35	0.0035	0.2075	0.47	2.0	1400	25	1586.0	1604.0	1594.0	10.0	459,040	252,036
25	26, 120	A11, A18, A19, A20	70.2	225.0	720	72,492	50.3	190,111	262,603	182.4	2.5	656,507	455.9	12	0.79	0.0022	0.2816	0.57	2.1	1650	24	1580.0	1597.0	1587.0	10.0	1,074,463	417,956
32	None	A23, A24, A25, A31, A32, A33, A34, A35, A36, A37	283.9	921.0	2477	337,232	234.2		337,232	234.2	2.5	843,079	585.5	12	0.79	0.0022	0.3616	0.67	2.1	2100	24	1556.0	1580.0	1570.0	10.0	1,074,463	231,384
24	25, 32	A17	18.2	77.5	248	24,795	17.2	599,835	624,630	433.8	2.5	1,561,575	1084.4	12	0.79	0.0050	0.4442	0.79	3.2	1200	23	1546.0	1580.0	1564.9	15.1	1,619,814	58,240
23	2, 24	A13,A15, A16	70.0	227.3	727	73,238	50.9	3,067,942	3,141,180	2,181.4	2.5	7,852,951	5453.4	24	3.14	0.0035	0.4205	0.75	4.3	650	1	1540.0	1572.0	1558.6	13.4	8,625,105	772,154
36	None	A27, A28, A29, A30	92.1	288.1	922	92,704	64.4		92,704	64.4	4.0	370,817	257.5	8	0.35	0.0035	0.3717	0.68	2.0	1550	35	1543.0	1560.0	1548.0	12.0	459,040	88,223
35	36	A26	20.7	62.1	199	19,869	13.8	92,704	112,573	78.2	4.0	450,293	312.7	8	0.35	0.0040	0.4223	0.75	2.2	1300	1	1536.8	1560.0	1542.2	17.8	490,735	40,442
1	23, 35	None	-	-	-	-	0.0	3,253,754	3,253,754	2,259.6	2.5	8,134,384	5648.9	24	3.14	0.0035	0.4356	0.77	4.3	700	10	1531.0	1565.0	1536.7	28.3	8,625,105	490,721
10 (PLANT)	1	None	-	-	-	-	0.0	3,253,754	3,253,754	2,259.6	2.5	8,134,384	5648.9	24	3.14	0.0035	0.4356	0.77	4.3	0		1525.0	1555.0	1534.0	21.0	8,625,105	490,721

1. Peaking Factor = 4.0 for 8 & 10-inch pipes, 2.5 for 12-inch and larger
2. Design Criteria - 100 gpcpd with 3.2 people per LDR and SR unit, 2.0 people per MDR and HDR unit
3. Commercial property at 2,500 gallons per acre per day, Park and Public Facility at 250 gallons per acre per day
4. Design slope used ranges from greater of minimum slope or 0.2 percent to maximum of 0.60 percent slope
5. Schools estimated at 35 gallons per day per student

0.013 mannings n value used for all sewers

DEPARTMENT OF THE AIR FORCE
AIR EDUCATION AND TRAINING COMMAND

29 December 2004

Mr. James R. Mitchell
Director, Community Initiatives Team
56th Fighter Wing
14185 West Falcon Street
Luke AFB AZ 85309-1629

Mr. Matthew Holm, Principal Planner
Maricopa County Planning and Development
411 North Central Avenue, 3rd Floor
Phoenix AZ 85004-8369

Re: Case #Z2002066 and DMP2002003 Sunhaven Ranch, L.L.C.
Beus Gilbert letters dated 14 April 2004 and 23 December 2004
Luke AFB letter dated 29 April 2004

Dear Mr. Holm

Thank you for the opportunity to provide additional comments on the proposed Sunhaven Ranch Development. Sunhaven Ranch is located on 2120.1-acres at the northeast side of Grand Avenue between the Dixeleta Road extension and Dove Valley Road. Approximately 20% of the development is located inside the Luke AFB Auxiliary Field #1 2004 65 Ldn, "high noise and accident potential zone".

In response to the second request from Mr. Gilbert's office, we have reviewed the modified proposed development as submitted to determine if the plan is still compatible with Luke AFB's operations. Sunhaven Ranch will be composed of Mixed Use Commercial, Light Industrial, Small, Medium and High Density Residential, Parks and Drainage. The single and multi-family residential will have a total of 9,017 dwelling units (du), resulting in a gross density of 4.25 du/acre.

We noticed that the proposed residential locations have been rearranged to reduce densities inside the 65 Ldn while increasing densities further away. We also recognize that this property is located adjacent to a major thoroughfare (Grand Avenue) and an operating railroad track that already subjects the property to noise issues that serve to mitigate the overall impact of the noise created by our flying mission.

Based on the above, we conclude that the proposed plan for development as submitted remains compatible and consistent with military operations at Aux Field #1 and the 2004 F-16 Noise Contours. Under recently passed state law, properties within the current noise contours of Aux Field #1 are subject to the land use compatibility standards listed in A.R.S. § 28-8481 (J). This letter however is intended to be a compatibility agreement that will limit the application of

that land use compatibility table on your property. Luke AFB will continue to consider the submitted development, together with the maximum residential densities depicted thereon, as compatible and consistent with the high noise and accident potential zones of Aux Field #1 for as long as the 2004 F-16 Noise Contours are effective and utilized as the noise contours for Aux Field #1. Furthermore, we support the approval of any required comprehensive or general plan amendment, which may be required to reflect the submitted densities.

If you have any questions, please contact my Community Planner, Mr. Bob Dubsky at (623) 856-6195.

Sincerely

JAMES R. MITCHELL

cc:
Colonel Peter A. Costello III, Vice Commander, 56th Fighter Wing
Mr. Desmond McGeough, Planner, City of Surprise
Mr. Paul Gilbert, Beus Gilbert PLLC, 4800 No. Scottsdale Rd., St. 6000, Scottsdale, AZ 85251

Nadaburg School
District No. 81

Superintendent

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Business Manager
Sara DiPasquale

Governing Board

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Nadaburg Elementary
Principal
Bill Collins

Assistant Principal
Jerry Stultz

[illegible] West Dove Valley Road
PH 623.388.2321
Fax 623.388.2201

December 16, 2005

To Whom It May Concern:

Please be advised that representatives of Element Homes (the "Developer") have met with District administration regarding the proposed Sunhaven development project.

The two parties have reached tentative agreement on the donation of three elementary school sites to be located on appropriate sites within the residential development. The District expects to enter into a legal agreement with the Developer, prior to approval of the final plat.

Please feel free to contact my office if you require additional information.

Sincerely,

Sara DiPasquale
Business Manager

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COMMUNITY DEVELOPMENT